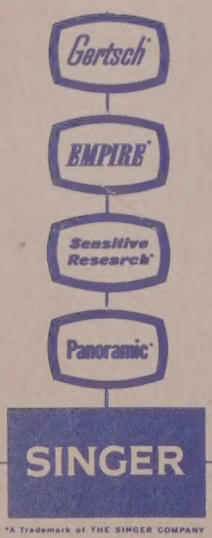
INSTRUCTION MANUAL

Gertsch*

MAINTENANCE
FOR
MODEL SSG-1
SIGNAL GENERATOR
MILITARY TYPE AN/GRM-59

C.A. SORENSEN



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Precision electrical and electronic instruments for measurement

THE SINGER COMPANY • METRICS DIVISION

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1. Model or Type
2. Serial Number
3. Description of trouble(2)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Contact Metrics Division, Bridgeport, Connecticut for *Commander**, *Empire**, *Panoramic**, and *Sensitive Research** instruments. Contact Metrics Division, Los Angeles, California for *Gertsch** instruments.

(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

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Figure 1-1. Model SSG-1 Signal Generator/Frequency Meter/Deviation Meter

SECTION I
INTRODUCTION

1-1. GENERAL.

1-2. This instruction manual contains maintenance data for the Model SSG-1 Signal Generator/Frequency Meter/Deviation Meter. Refer to the operation manual for a complete description, operation instructions, and general theory of operation.

1-3. Except for calibration of the 1 MC crystal (Section II), no maintenance on a regularly scheduled basis is required. Lubrication, adjustments, and cleaning need only be performed as part of repair.

1-4. GENERAL MAINTENANCE.

1-5. General maintenance data is included in Sections II, III, and IV. Sections II and III include checkout procedures which may also be used to localize troubles to an individual circuit, circuit board, or assembly.

1-6. Section II includes a simplified checkout procedure which may be used as a pre-operation checkout. This checkout may be accomplished without the use of test equipment. The section also includes the crystal calibration procedure.

1-7. Section III includes a detailed checkout procedure which may be used as a final test of a repaired unit. This checkout may be performed without removing any covers from the unit.

1-8. Section IV includes the following data on the overall unit:

a. A simplified block diagram

b. Interconnection diagrams

c. Assembly and disassembly procedures

d. A parts list for the overall unit.

1-9. In addition, power distribution diagrams for the unit are included in Section XXI.

1-10. SPECIAL TOOLS AND TEST EQUIPMENT.

1-11. SPECIAL TOOLS. Special tools and adapter cables recommended for maintenance are listed in Table 1-2.

1-12. STANDARD TEST EQUIPMENT. The test equipment required to perform the maintenance outlined in any section is listed within that section.

1-13. ACCESSORIES.

1-14. Equipment accessories are listed in Table 1-2.

TABLE 1-1. SPECIFICATIONS

FREQUENCY	
Signal Generator Range	5 CPS to 500 MC
Frequency Meter Range	10 KC to 1 GC
Accuracy:	
After crystal warm up	±0.00001%
Before crystal warm up	±0.005%
Stability	±0.00001% during any 8 hour period
Resolution:	
50 CPS to 50 MC	1 cps
50 MC to 500 MC	10 cps
Display	8 place Nixie readout
RF OUTPUT	
Range	0 to -130 dbm, continuously variable (50 Ω from 10 KC to 500 MC; 600 Ω from 5 cps to 10 KC)
Accuracy (At Frequencies Greater Than 1 MC)	
0 to -20 dbm	±1 db
-20 to -130 dbm	±2 db
MODULATION AMPLITUDE (Frequencies Greater Than 200 KC)	
Level	0 to 50%, continuously variable
Internal	400 or 1000 cps tone
External	100 cps to 10 KC, 1 vrms required for 50% modulation

TABLE 1-1. SPECIFICATIONS (CONT)

MEASUREMENT SENSITIVITY	500 μv (across 50 ohms) required for measurement
DEVIATION MEASUREMENTS	
Range	0 to 5 KC low, 0 to 15 KC high
Accuracy	±5% of full scale
ZERO BEAT INDICATORS	
Aural	Headset
Visual	Meter
EXTERNAL SYNTHESIZER DRIVE	1 MC, 1 vrms across 50 ohms
CRYSTAL CALIBRATION OUTPUT	1 vrms across 50 ohms
INPUT POWER	115/230 vac, 55 to 450 cps, 150 VA
DIMENSIONS	16"W by 18"H by 20"D
WEIGHT	102 pounds

TABLE 1-2. ACCESSORIES AND SPECIAL TOOLS

ITEM	F	O	USE	PART NO.	MFR
Head phone, 500 ohms	X		Monitoring beat note and audio	HFW-91	Telex
Cable, Type N to type N, 6 ft (W2)	X		Signal connections	WA-84	Singer
Cable, Type N to type BNC, 6 ft (W3)		X	Signal connections	WA-85	Singer
Phone Plug		X	Adapt phone output to binding posts	1285	Pomona
Antenna	X		For frequency meter or deviation meter tests	EA-24	Singer
Wrench		X	Installing and removing piston capacitors	T-151	Singer
Wrench	X		Installing and removing turret boards	T-150	Singer
Spanner Wrench		X	Installing and removing high frequency circuits		Singer
Expander		X	Installing plungers in piston capacitors		Singer
Board Puller	X		Installing and removing circuit boards	OM-1506	Singer
Circuit Board Extender		X	Servicing boards in the phase lock module	1865	Singer
Circuit Board Extender		X	Servicing boards in the phase lock module	1866	Singer
Circuit Board Extender		X	Servicing boards in the power supply module	1867	Singer
Cable Assembly		X	Servicing modules which plug into the front	1892	Singer
Harmonic Generator/Mixer		X	Measuring frequencies above 1 GC	PA-14	Singer

F = Furnished with the equipment
O = Optional, available at additional cost

SECTION II
FIELD MAINTENANCE

2-1. GENERAL.

2-2. This section includes a simplified checkout procedure which may be used as a pre-operation check and a 1 MC calibration procedure. For a more detailed checkout procedure, refer to Section III.

2-3. SIMPLIFIED CHECKOUT PROCEDURE.

2-4. To checkout the unit, proceed as follows:

a. Check that OVEN light cycles on and off after a suitable warm-up. Failure of the light to cycle on and off indicates troubles in the crystal oven circuit (Section XXII) or the power input circuit (Section XXI).

b. Turn FREQUENCY MODE switch to the FREE position and check that one of the band indicators is lit. Failure of the band lights indicates trouble in the input power circuit, the 6.3 vac supply (Section XXI) or in the bulb.

c. Turn BAND SELECT switch to an alternate band and check (audibly) that the turret drive system is operating. Failure of the turret drive indicates troubles in the 28 vdc supply (Section XXI) or the drive assembly (Section XXXVII).

d. Turn FREQUENCY MULTIPLIER switch to the X1 position. Check that a level set indication can be obtained on the RF OUTPUT meter with the RF LEVEL control. Repeat procedure on all bands.

(1) If level set indication cannot be obtained on any band, the trouble may be in the level set module (Section XVIII) or the HFO circuits (Section XXXI).

(2) If level set indication cannot be obtained on one band only, the trouble is probably in HFO circuits (Section XXXI).

(3) If level set indication cannot be obtained on the 10 KC to 5 MC band, refer to Section XXVI.

e. Turn FREQUENCY MODE switch to the SET UP position and check that the Nixie tubes are lit. Failure of the Nixie tubes to light indicates trouble in the +200 vdc power supply (Sections XXI and XXII).

f. Set decade controls to any frequency within the selected band and tune the FREQUENCY control to obtain a peak indication on the TUNE-TO-MAX meter. Repeat procedure on each band.

(1) Failure to obtain a peak indication on any band indicates trouble with the phase lock system (Section V) or the Nixie control circuit (Section XXII).

(2) Failure to obtain a peak indication on one band only indicates trouble with the HFO circuit (Section XXXI).

(3) If mechanical difficulties with the FREQUENCY control are encountered, refer to Section XXXVIII.

g. Turn FREQUENCY MODE switch to the LOCK position and tune the FREQUENCY control to obtain a steady glow of the Nixie tubes. Failure to obtain a steady glow indicates trouble in the Nixie control circuit (Section XXII), the phase lock system (Section V), or the HFO circuits (Section XXXI). Repeat procedure on each band.

h. Turn the FUNCTION switch to GEN-LOW and operate the system to obtain a 1 KC output signal. Connect headset to the PHONES jack of the level set module. Check that a 1 KC tone can be heard in the headset and that the volume can be controlled with the VOLUME control. Failure to obtain a tone indicates troubles in the beat detector (Section XXX) or the level set module (Section XVIII).

i. Turn FREQUENCY MULTIPLIER switch to X10 position and repeat step d. If level set indication cannot be obtained, the trouble is in the multiplier circuits (Section XXXIV for 50 to 310 MC circuits or Section XXXV for the 310 to 500 MC circuits).

j. Turn FUNCTION switch to GEN-NORM and set up any frequency in excess of 1 MC. Turn MOD SELECT switch to 400 cps and check that 50% modulation may be applied to the output signal. Failure to obtain modulation level indicates troubles in the modulation module (Section XV) or the HFO circuit (Section XXXI).

k. To checkout the deviation module, refer to Section XII.

2-5. 1 MC CALIBRATION.

2-6. To ensure accuracy of the equipment, check the 1 MC crystal every 30 days. To check and adjust the crystal, a phase comparison receiver such as Gertsch Model PCR-1 is recommended.

a. Make certain that the Model SSG-1 is warmed up to operating temperature.

b. Connect 1 MC OUTPUT connector to the STANDARD input of the receiver.

c. Proceed with the frequency check.

d. Make certain that the crystal is accurate to one part in 10^7 or better. Adjust the MC ADJ capacitor and switch as required to obtain accuracy within limits. The adjustments are located under the removable plug on the back of the unit.

2-7. With a 1 MC standard accurate to 1 part in 10^8 or better, the crystal may be checked and adjusted as follows:

a. Make certain that the Model SSG-1 is warmed up to operating temperature.

b. Connect 1 MC output connector to one set (horizontal or vertical) of oscilloscope inputs.

c. Connect 1 MC standard to the other set of oscilloscope inputs.

d. Adjust oscilloscope to obtain a 1:1 Lissajous patterns.

e. A change in phase shift relations between the two inputs indicates a difference in frequency. A change which proceeds through a full 360° indicates a difference of 1 cycle. If the 1 cycle difference requires 10 seconds or more, the Model SSG-1 crystal is accurate to 1 part in 10^7 or better.

f. Adjust MC ADJ capacitor and switch as required to obtain accuracy within limits. The adjustments are located under the removable plug on the back of the unit.

SECTION III
SHOP CHECKOUT PROCEDURE

3-1. GENERAL.

3-2. This section contains a detailed checkout procedure which may be used as a final test of a repaired unit and as an aid in trouble shooting. The checkout may be performed without removing any covers. To gain access to individual circuits, assemblies, or components, refer to Section IV. Refer to Table 3-1 for a list of test equipment.

3-3. CHECKOUT.

3-4. To checkout the 1 MC circuit, proceed as follows:

a. Connect Model SSG-1 to a power source.

b. With an ambient temperature of 60°F or more, the oven light shall start cycling in 30 minutes or less.

c. Failure to warm up indicates trouble in the crystal oven circuit (Section XXII) or the power supply (Section XXI).

d. Perform calibration of 1 MC crystal as outlined in Section II.

e. Inability to calibrate indicates trouble in the 1 MC circuit (Section XXIII).

3-5. To check the frequency range and stability of the instrument, proceed as follows:

a. Connect frequency meter to the RF OUTPUT connector.

b. Operate Model SSG-1 in the GEN-NORM mode and set to the frequencies listed in Table 3-2.

c. Set the frequency meter to the harmonics or frequencies listed in the table.

d. Adjust Model SSG-1 frequency and output level controls as required to obtain a zero beat.

e. The zero beat shall be obtained within the tolerances listed in the table.

f. If readings within tolerance cannot be obtained on any bands, the trouble is probably in the phase lock system (Section V).

g. If readings can be obtained in the X1 range but not in the X10, the trouble is probably in the multipliers (Section XXXIV or XXXV).

3-6. To check the equipment in the 10 KC to 5 MC range, proceed as follows:

a. Connect counter to the RF OUTPUT connector. Operate the counter and the Model SSG-1 from the same 1 MC source.

TABLE 3-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Frequency Meter (Gertsch Model FM-6)	20 to 40 MC range	
Frequency Counter (HP Model 524)	5 cps to 5 MC range	
Power Meter (HP Model 431B)	5 MC to 500 MC frequency range -30 to +7 dbm power range	
Modulation Meter (Singer Model MM-120)	5 MC to 500 MC range 0 to 50% modulation range	
Audio Oscillator	0 to 10 KC frequency range 0 to 1 vrms output range	
1 MC Standard (James Knight Model FS-1000)	1 MC output	
Signal Generator		

TABLE 3-2. FREQUENCY RANGE

BAND	SCALE POINT	MODEL SSG-1 FREQUENCY (MC)	FREQUENCY METER FREQUENCY (MC)	TOLERANCE ± CPS
5-8	LOW	5	20	5
	MID	6.5	26	7
	HIGH	8	24	8
8-13	LOW	8	24	8
	MID	10.5	21	11
	HIGH	13	26	13
13-21	LOW	13	26	13
	MID	17	34	17
	HIGH	21	21	21
20-32	LOW	20	20	20
	MID	26	26	26
	HIGH	32	32	32
31-50	LOW	31	31	31
	MID	40	40	40
	HIGH	50	25	50
50-80	LOW	50	25	50
	MID	65	32.5	65
	HIGH	80	40	80
80-130	LOW	80	40	80
	MID	104	26	104
	HIGH	130	32.5	130
130-210	LOW	130	32.5	130
	MID	170	34.0	170
	HIGH	210	35	210
200-320	LOW	200	40	200
	MID	259	37	259
	HIGH	320	40	320
310-500	LOW	320	40	320
	MID	400	40	400
	HIGH	500	31.25	500

b. Operate Model SSG-1 in the GEN-NORM mode at the following frequencies:

(1) 10 KC
(2) 1.111111 MC
(3) 1.222222 MC
(4) 1.333333 MC
(5) 1.444444 MC
(6) 1.555555 MC
(7) 1.666666 MC
(8) 1.777777 MC
(9) 1.888888 MC
(10) 1.999999 MC
(11) 5 MC

c. The counter and the Model SSG-1 shall agree within ±1 count.

d. If trouble is encountered at all frequencies, the trouble is probably in the 10 KC to 5 MC circuits (Section XXVI).

e. If trouble is only encountered at one frequency, the trouble is probably in the phase lock system (Section V).

3-7. To check the 5 CPS to 10 KC range, proceed as follows:

a. Connect counter to the PHONES jack of the level set module.

b. Operate Model SSG-1 in the GEN-LOW mode at the following frequencies:

(1) 5 CPS

(2) 100 CPS

(3) 1 KC

(4) 5 KC

(5) 10 KC

c. The counter and the Model SSG-1 shall agree within ±1 count.

d. If trouble is encountered, the trouble is probably in level set module (Section XVIII) or the beat detector (Section XXX).

3-8. To check the power output, proceed as follows:

a. Connect a 50 ohm load to the RF OUTPUT connector through a 6 foot cable. Connect microwave power meter to the load.

b. Operate the Model SSG-1 in the GEN-NORM mode and set to the following frequencies:

(1) 4 MC

(2) 6.5 MC

(3) 10.5 MC

(4) 17 MC

(5) 26 MC

(6) 40.5 MC

(7) 65 MC

(8) 105 MC

(9) 170 MC

(10) 260 MC

(11) 405 MC

c. At each frequency set the Model SSG-1 output to 0 and -20 dbm.

d. Check that the power meter and the attenuator setting agree within ±1 db.

e. If a level set indication cannot be obtained, the trouble is probably in the HFO circuit (Section XXXI).

f. If a level set indication can be obtained, the trouble is probably in the level set module (Section XVIII).

3-9. To check modulation characteristics, proceed as follows:

a. Connect modulation meter to the RF OUTPUT connector.

b. Connect counter to the audio output of the modulation meter.

c. Operate the Model SSG-1 in the GEN-NORM mode and set to the following frequencies:

(1) 4 MC

(2) 6.5 MC

(3) 40.5 MC

(4) 65 MC

(5) 400 MC

d. At each frequency, set MOD SELECT switch to 400 cps. Adjust MOD LEVEL control as required to obtain a 30% indication on the PERCENT MODULATION meter.

e. The percent modulation indication of the modulation meter shall be 30% ±5%.

f. The modulation frequency shall be 400 cps ±5%.

g. Repeat steps d, e, and f at 1000 cps.

h. Connect audio oscillator to the EXT MOD connector.

i. Set Model SSG-1 to 40.5 MC.

j. Set audio oscillator to 100 cps and 1 vrms.

k. Check that 50% modulation can be obtained.

l. Repeat steps i, j, and k at 10 KC.

m. If modulation frequency is out of specification, the trouble is probably in the modulation module (Section XV).

n. If modulation amplitude cannot be obtained at any frequency, the trouble is probably in the modulation module (Section XV).

o. If modulation amplitude cannot be obtained in the X1 range, the trouble is probably in the HFO circuit (Section XXXII).

p. If modulation amplitude cannot be obtained in the X10 range, the trouble is probably in the modulator (Section XXXVI).

3-10. To check frequency measurement sensitivity, proceed as follows:

a. Connect signal generator to the MEAS INPUT jack. Operate signal generator at 20 MC and an output of 500 μv.

b. Operate Model SSG-1 in the measure function to measure the 20 MC input.

c. Check that a distinguishable beat note can be obtained. (For example, a 1 cps beat note can be detected visually on the beat meter or an audio tone can be detected with the headset.)

d. Repeat measurement procedure at 40, 400, and 500 MC. Leave the frequency meter set to 20 MC.

e. Failure to obtain a beat note indicates trouble in the beat detector (Section XXX) or the level set module (Section XVIII).

SECTION IV

MAIN CHASSIS

(See figures 4-3 thru 4-8)

REF DESIG	FIG. NO.	ITEM	MFR	PART NO.
A17	4-5	Power Supply Module (See Section 21)	Singer	AA-1203
A19	4-3	Level Set Module (See Section 18)	Singer	AA-1204
A22		Deviation Module (See Section 12)	Singer	AA-1205
A25	4-3	Modulation Module (See Section 15)	Singer	AA-1206
A28	4-6	Beat Detector Module (See Section 30)	Singer	AA-1201
A29	4-5	1 MC Switching Module (See Section 23)	Singer	AA-1173
A30	4-8	Modulator Assy (See Section 36)	Singer	AA-1233
A31	4-8	Multiplier (See Section 34)	Singer	AA-1230
A32	4-8	Amplifier (See Section 34)	Singer	AA-1232
A33	4-8	Amplifier (See Section 34)	Singer	AA-1231
A34	4-8	Doubler (See Section 35)	Singer	AA-1228-1
A35	4-8	Amplifier (See Section 35)	Singer	AA-1228-2
A36	4-8	Buffer (See Section 33)	Singer	AA-1236
A37	4-8	Reference Voltage (See Section 31)	Singer	AA-1237
A68	4-5	Phase Lock Module (See Section 5)	Singer	AA-1162
A69	4-5	Line Filter Assy	Singer	AA-1251
A70	4-8	Tuner Assy (See Section 31)	Singer	AA-1224-1
A71	4-8	HFO Assy (See Sections 31 and 32)	Singer	AA-1224-2
A72	4-8	Tuner Assy (See Section 34)	Singer	AA-1224-3
A73	4-8	Tuner Assy (See Section 34)	Singer	AA-1224-4
A74	4-8	Tuner Assy (See Section 34)	Singer	AA-1224-5
A75	4-8	Tuner Assy (See Section 34)	Singer	AA-1224-6
A76	4-7	Drive Mechanism (See Section 38)	Singer	AA-1177
A77	4-4	Dial Assy (See Section 38)	Singer	AA-1172
AT1	4-3	Attenuator	Singer	AA-1217
B1	4-8	Motor Assy (See Section 37)	Singer	AA-1200
C1 thru C27	4-8	Capacitor, Feed thru	Allen-Bradley	FB2B-102W
C28	4-8	Capacitor, variable	Singer	SC-525
C29	4-8	Capacitor, variable	Singer	SC-525
C30	4-8	Capacitor, variable	Singer	SC-524
C31	4-8	Capacitor, variable	Singer	SC-524
C32	4-8	Capacitor, variable	Singer	SC-524
C33	4-8	Capacitor, variable	Singer	SC-524
C34		Capacitor, variable	Singer	SC-525
C35 thru C41		Not Used		
C42 thru C59	4-6	Capacitor, Feed-thru	Allen-Bradley	FB2B-102W
C60 thru C76	4-6	Capacitor, Feed-thru	Allen-Bradley	FB2B-102W
C77		Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
CP1	4-7	Adapter, Coaxial		UG-491 A
CP2	4-7	Tee, Coaxial		UG-274 U
CR1	4-8	Diode	Semtec	SC-2
CR2	4-8	Diode	Semtec	SC-2
CR3	4-8	Diode	Semtec	SC-2
CR4	4-6	Diode	Semtec	SC-2
DS1 thru DS8	4-4	Nixie Tube	Burroughs	B5092
DS9	4-4	Lamp, Indicator	GE	NE86
DS10	4-4	Lamp, Indicator	GE	NE86
DS11		Not Used		
DS12 thru DS18	4-4	Lamp, Indicator	GE	TS51
DS19	4-4	Lamp, Indicator	GE	TS1819
E1A	4-8	Contact Assy	Singer	AA-1209
E1B	4-8	Circuit Board	Singer	OM-1264
E2	4-8	Terminal	Useco	1413-B
E3	4-4	Contact Board	Singer	OM-1542
E4	4-4	Contact Board	Singer	OM-1542
E5 thru E10	4-8	Contact Assy	Singer	AA-1207

(Continued on page 4-11)

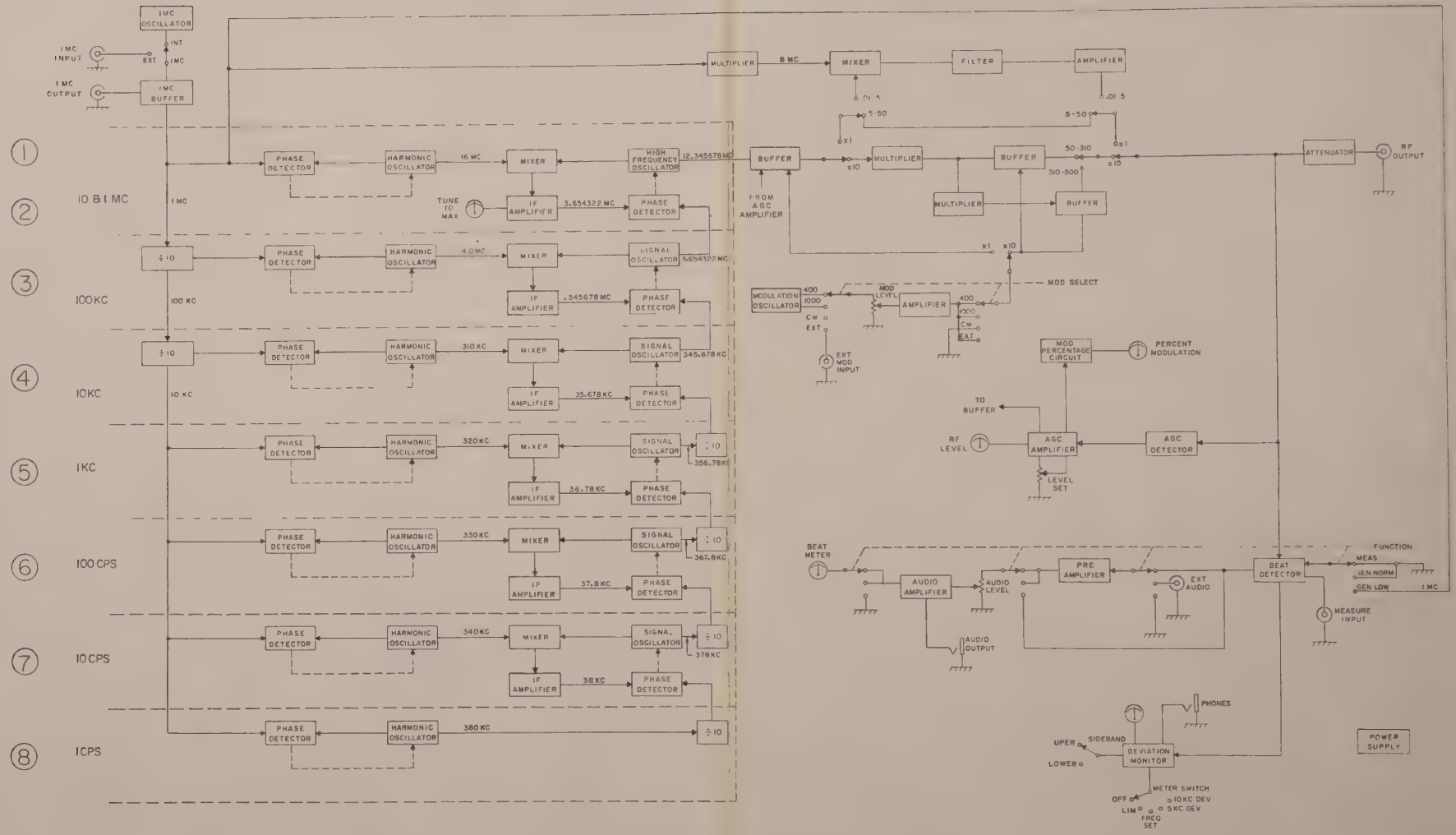


Figure 4-1. Block Diagram

4-1. GENERAL.

4-2. Refer to figure 4-1 for a simplified block diagram of the unit and to figure 4-2 for an interconnection diagram. Refer to the operation manual for a general theory of operation. Refer to figures 4-3 through 4-8 for location of components on the main chassis.

4-3. DISASSEMBLY.

4-4. To gain access to components located on the front of the front casting (see figures 4-3 and 4-4), proceed as follows:

a. Remove knobs MP1 through MP12.

b. Remove the four screws which attach the top panel MP16 and remove the panel.

c. The components located on the top part of the front panel are now accessible.

d. To remove a plug-in module (A19 or A25), rotate the applicable hold-down screw CCW. When the screw disengages, the module may be pulled out by hand.

e. To gain access to the attenuator, remove knob MP13. Panel MP18 may now be removed.

4-5. To gain access to main chassis components (see figures 4-5, 4-6, and 4-7), proceed as follows:

a. Disengage the 12 studs H1 (figure 4-5) which secure cover MP19 and remove the cover.

b. To remove power supply module A17, disengage the four screws which attach the module to the chassis. The module may be moved without disconnecting the electrical connectors.

c. To gain access to sub-modules of the phase lock module A68, remove the snap-on cover. The board puller, which is secured to the side of the power supply module, may be used to pull the sub-modules. Refer to Section V for detail information on the module.

d. To remove the phase lock module A68, remove the snap-on cover and all sub-modules. The six screws which attach the module to the front casting are then accessible.

4-6. To gain access to the turret and turret drive components (see figure 4-7), proceed as follows:

a. Remove the 18 screws which attach the bottom cover MP24.

b. Turn switch S4 to the BOARD REMOVAL position.

c. Connect instrument to power source.

d. Turn FREQUENCY MODE switch to the FREE position.

e. Turn BAND SELECT switch to any alternate position.

f. The turret will rotate to the service position. The index mark on the cam of motor B1 will align with the index mark on the cam housing.

CAUTION

The turret must be in the board removal position before removing assemblies or damage to the equipment will result.

g. Remove the six screws which attach shield MP25.

h. To remove a turret assembly A70 through A75, make certain that contacts E5 through E10 are positioned between the contact buttons of the assemblies. The board puller of the power supply module A17 may be used to pull the assembly from the turret. Use tool MP26 to remove a set of band components from a turret assembly.

NOTE

Use care within the turret and cavity area. Any change in lead length or lead position can change tuning.

4-7. REASSEMBLY.

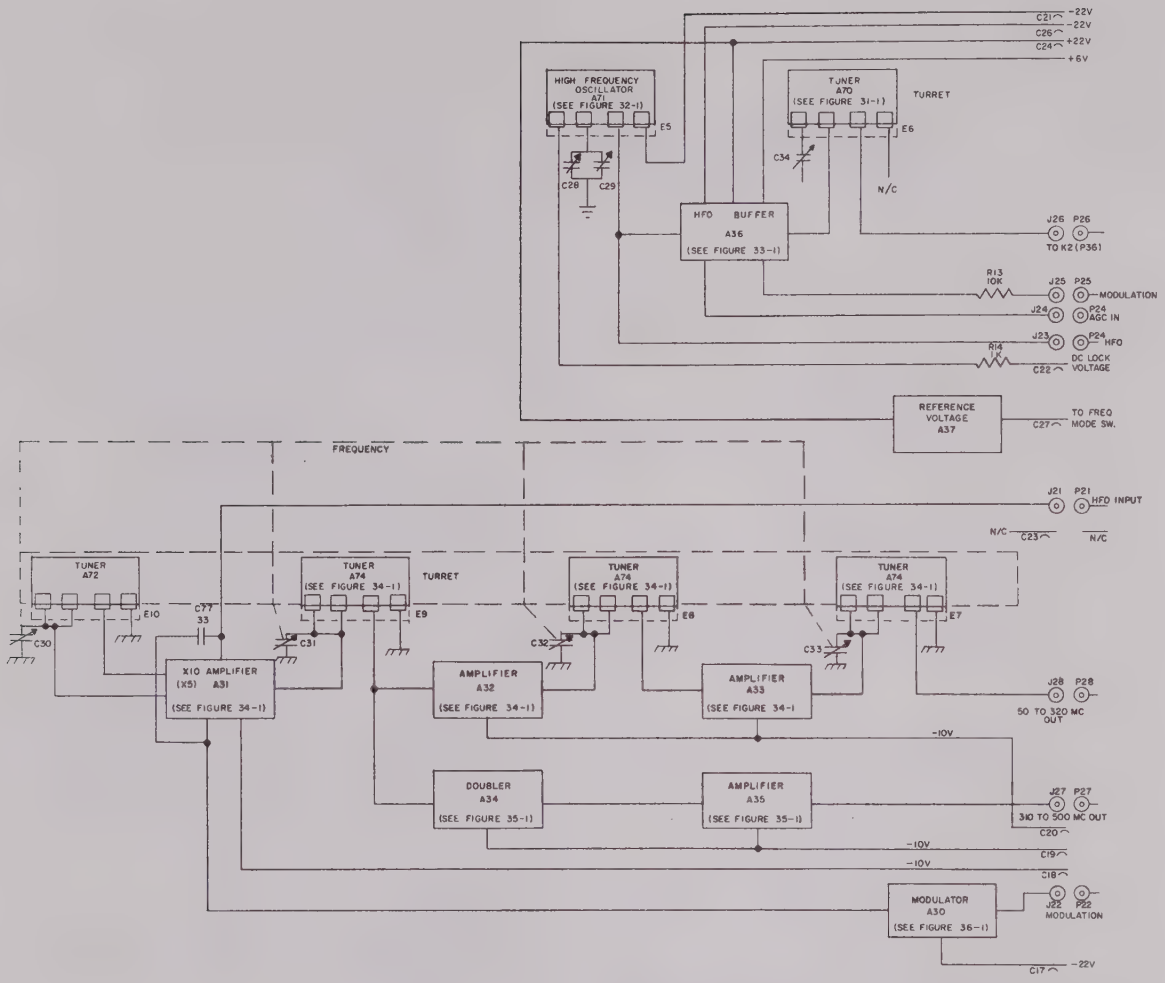
4-8. Reassembly is essentially the reverse of disassembly. Note the following:

a. Refer to Section XXXVII for reassembly and adjustment of the turret drive assembly.

b. Refer to Section XXXVIII for reassembly and adjustment of the tuning mechanism and dial assembly.

c. Make certain switch S4 is in the OPERATE position.

d. Make certain all covers and shields are replaced and securely fastened. The covers and shields provide both internal and external RF shielding.



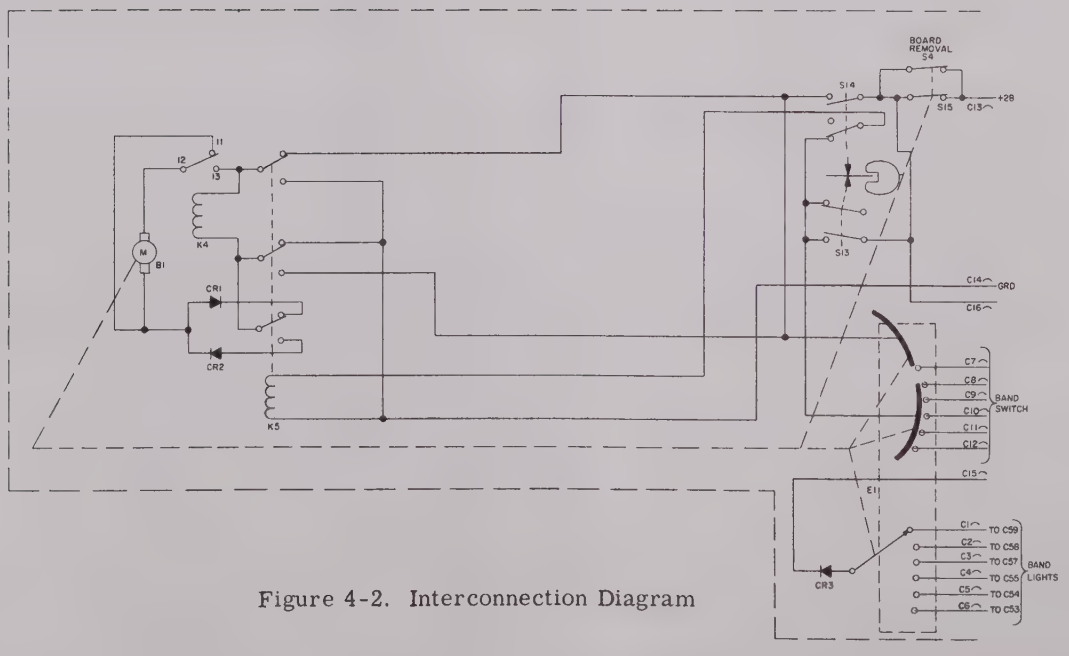
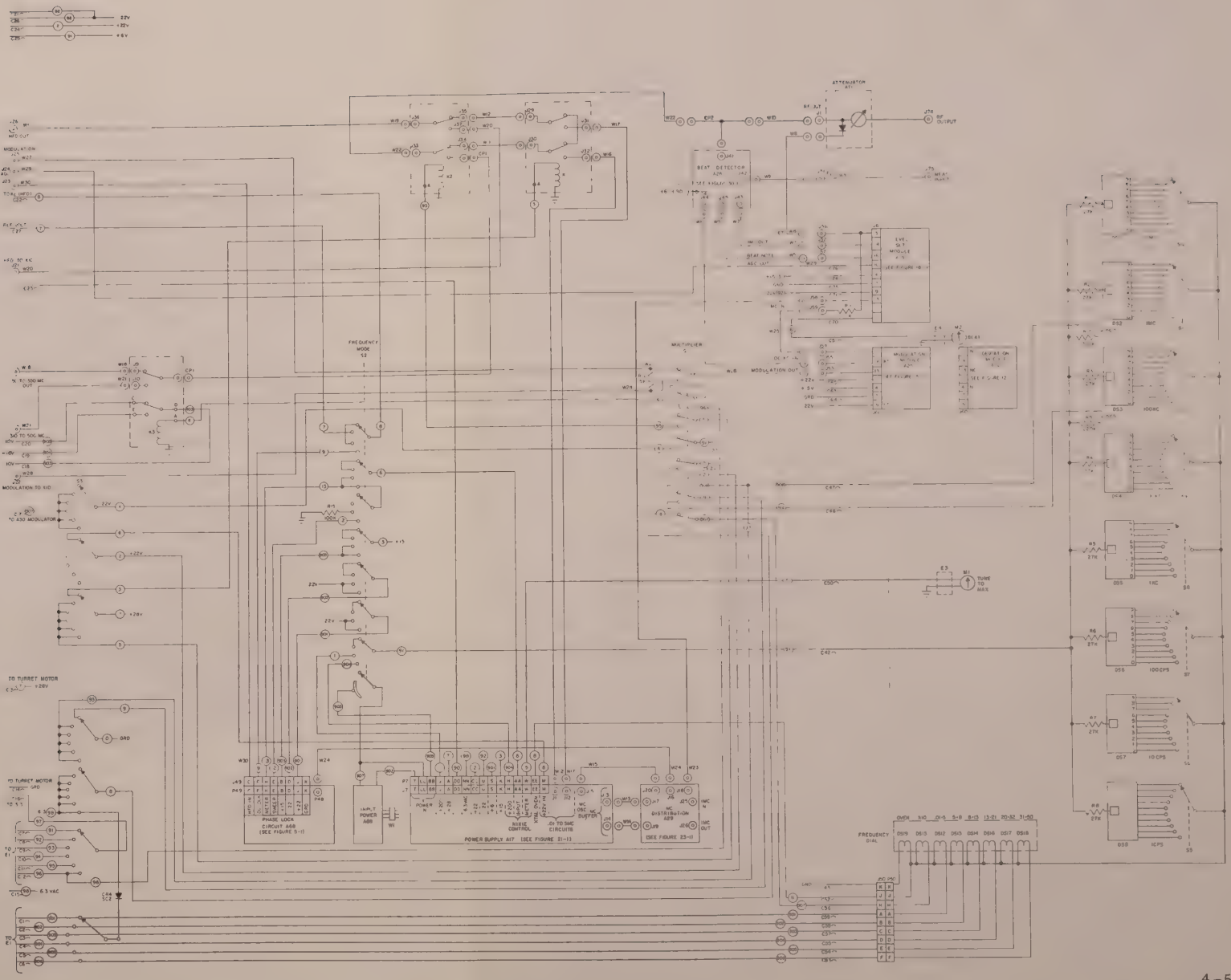


Figure 4-2. Interconnection Diagram


ATTENUATOR
BEAT DETECTOR
MULTIPLIER
FREQUENCY MODE S2
PHASE LOCK CIRCUIT A68 (SEE FIGURE 5-11)
INPUT POWER A69
NIXIE CONTROL
POWER SUPPLY A17 (SEE FIGURE 21-13)
DISTRIBUTION A29 (SEE FIGURE 23-11)
TO TURRET MOTOR
FREQUENCY DIAL

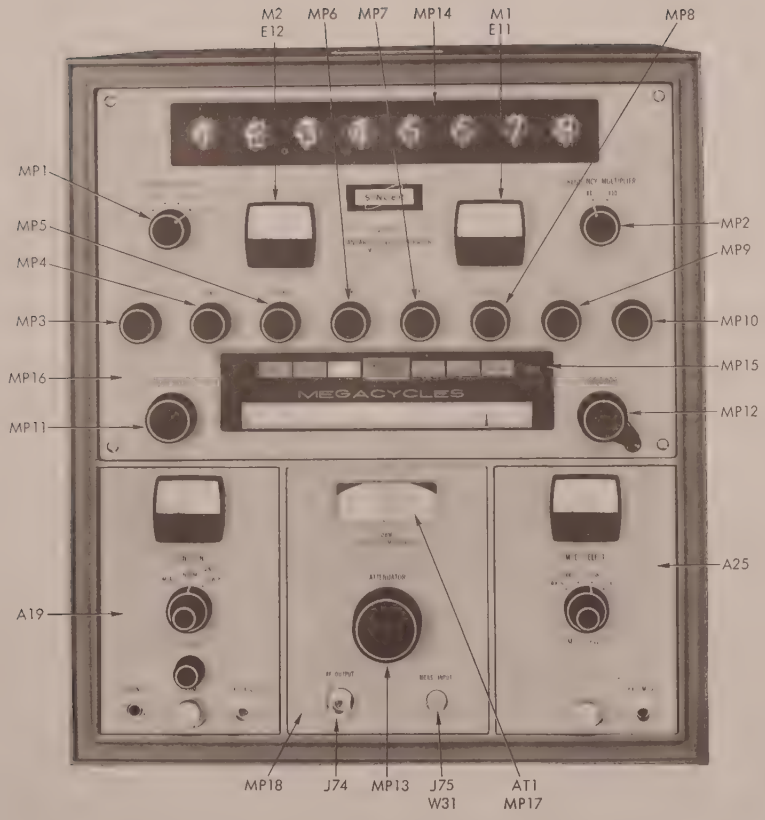


Figure 4-3. Front Panel

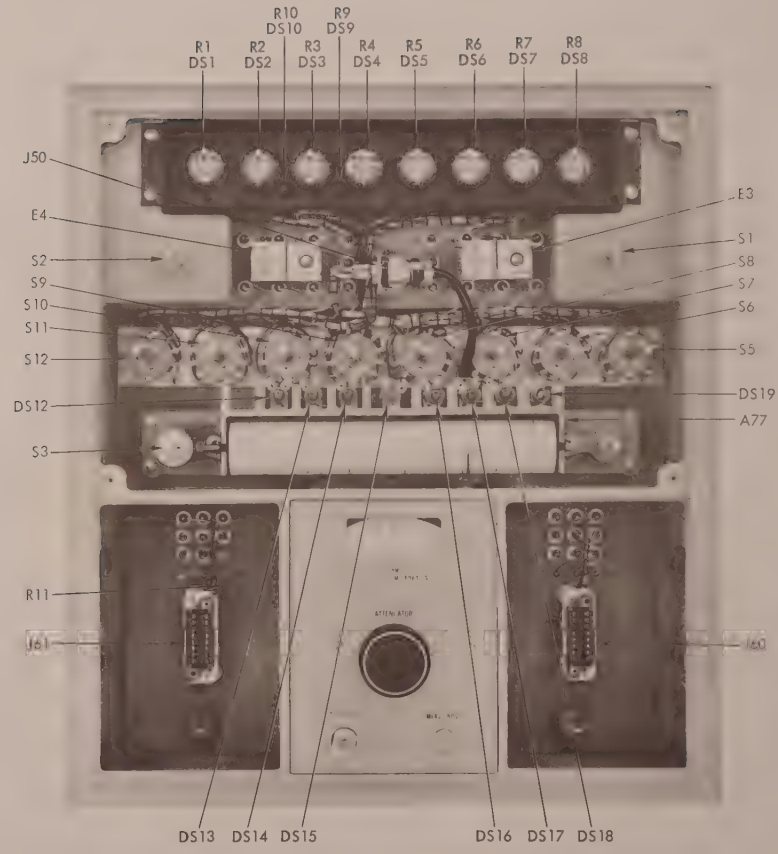


Figure 4-4. Front Casting

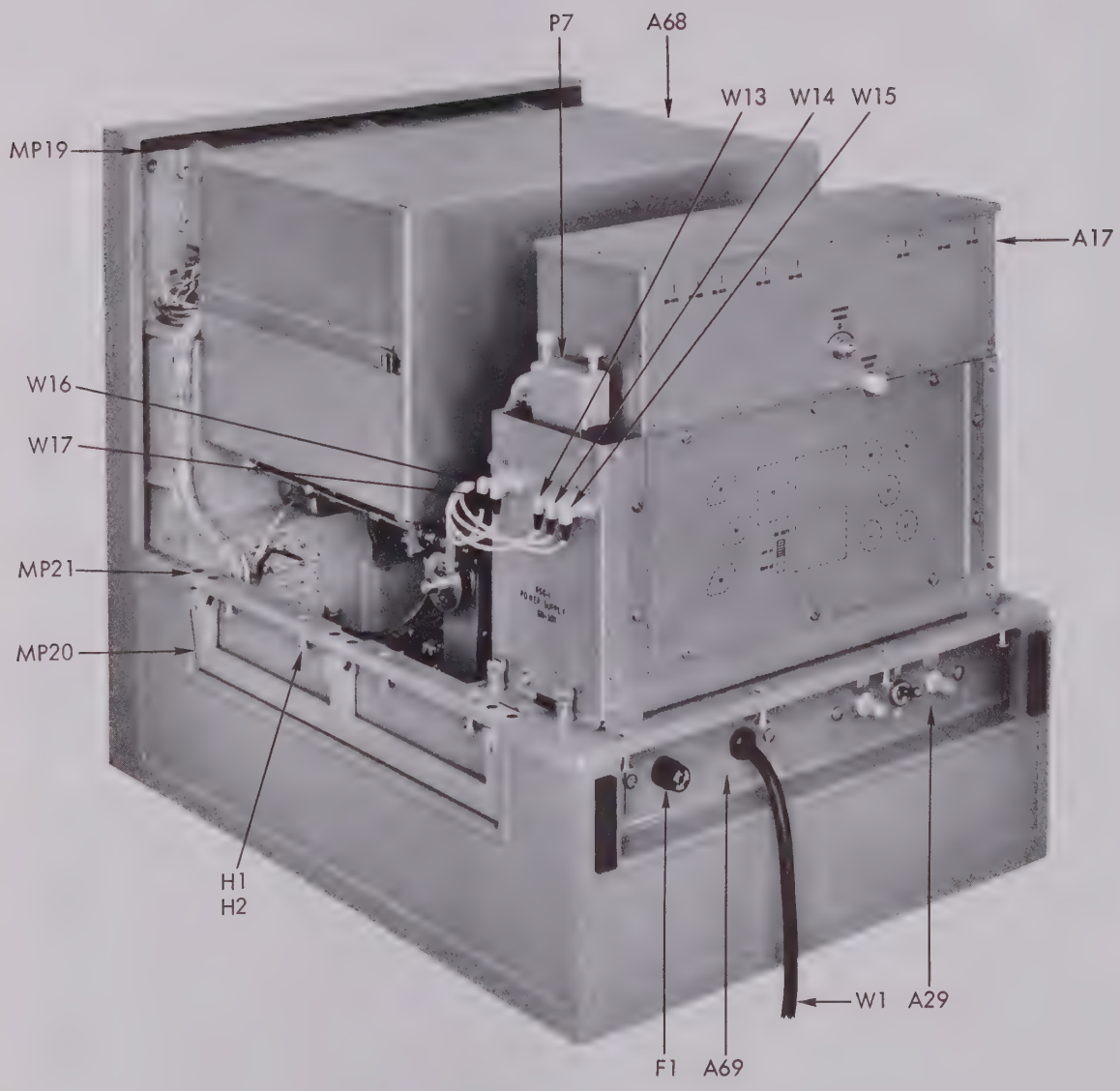


Figure 4-5. Main Chassis

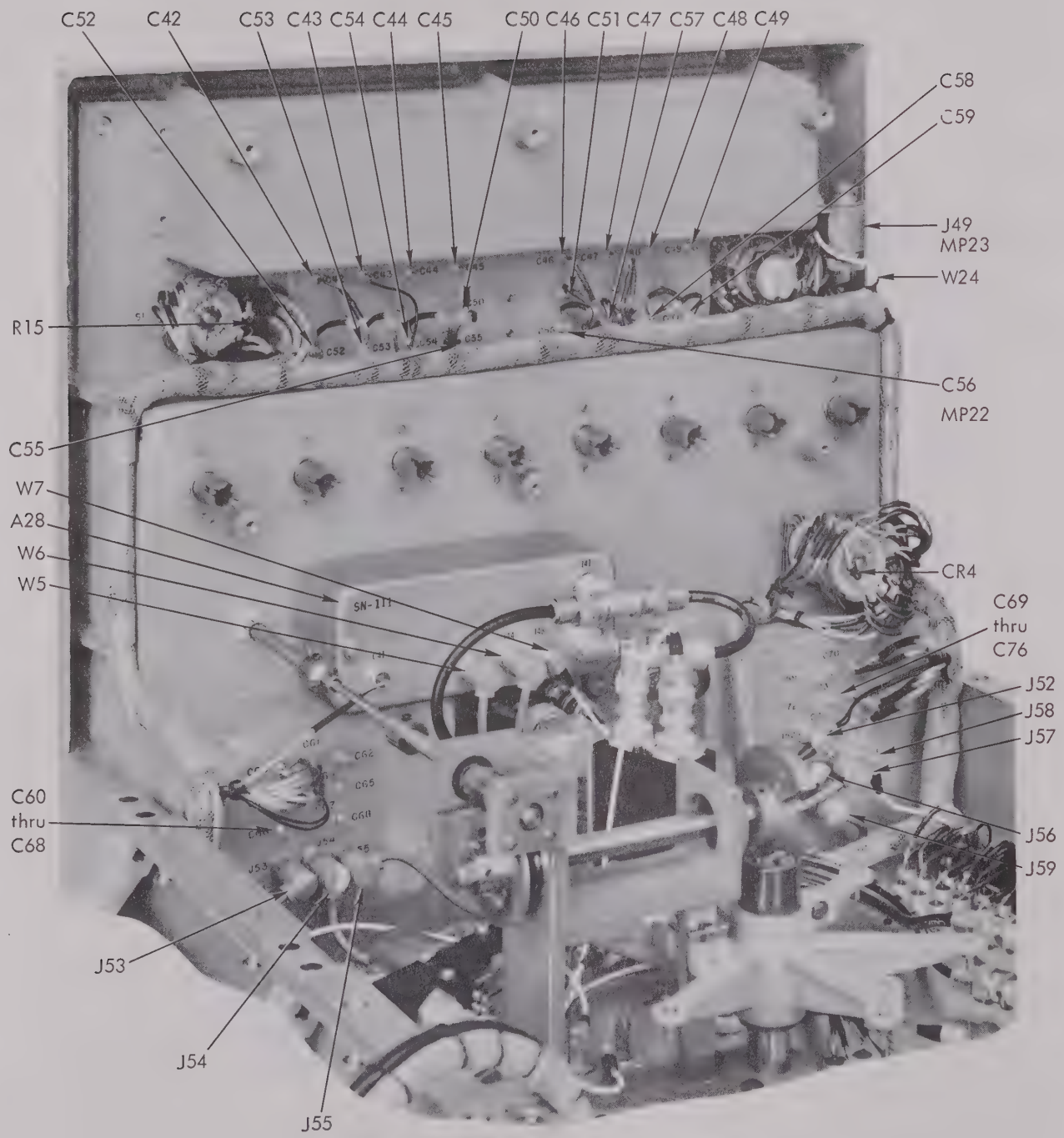


Figure 4-6. Main Chassis, Internal View

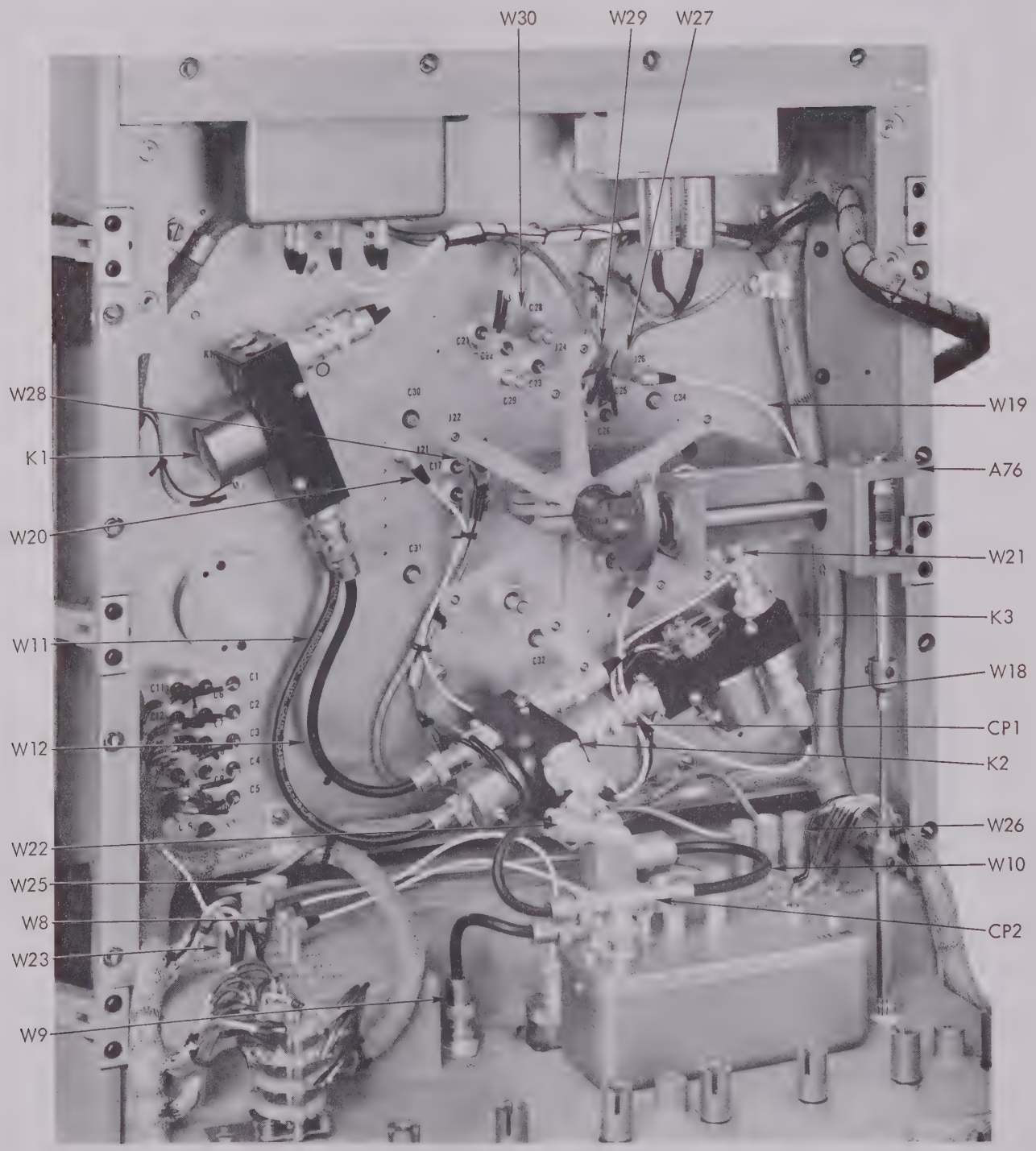


Figure 4-7. Main Chassis, Internal View

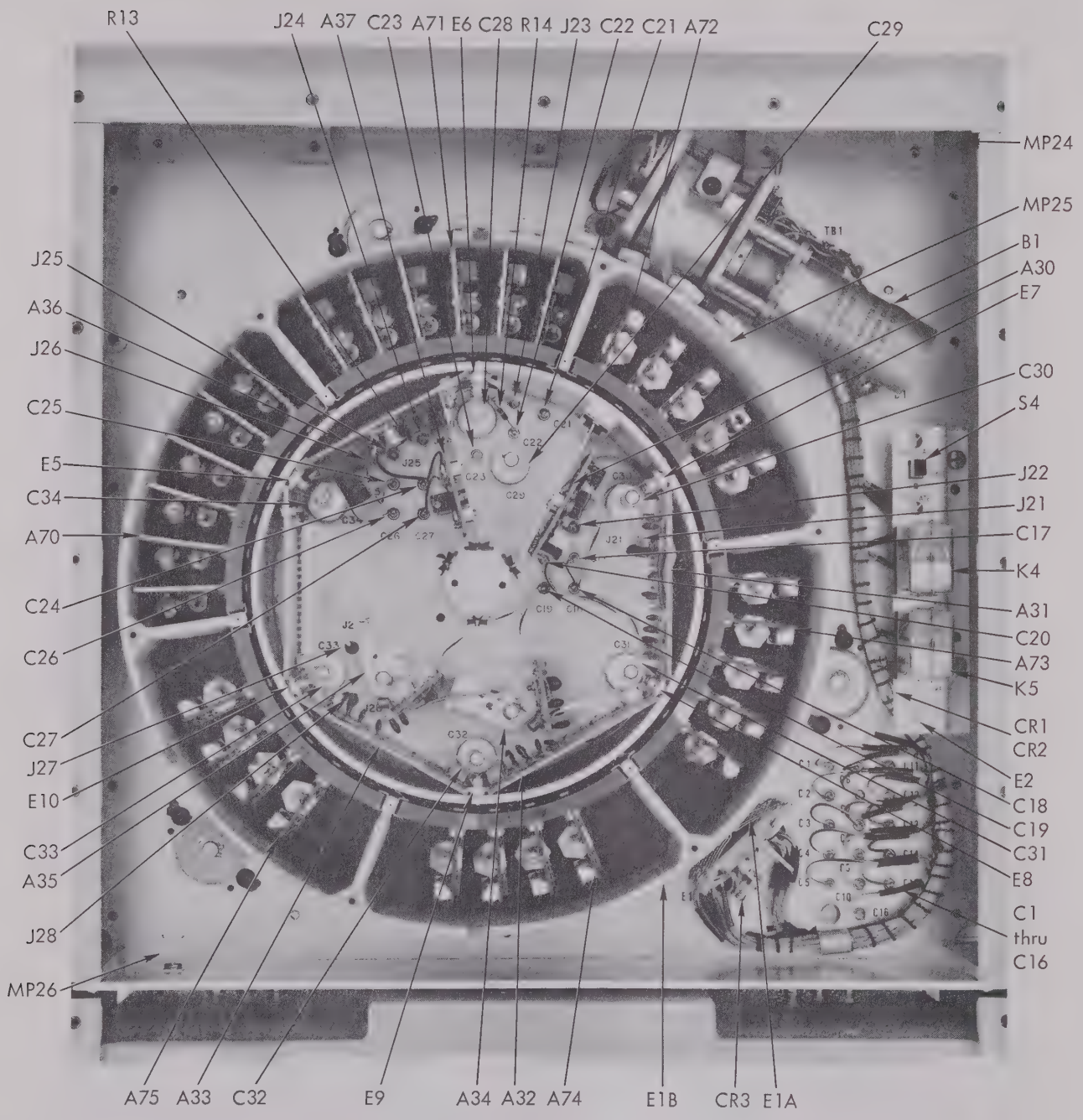


Figure 4-8. Cavity

REF DESIG	FIG. NO.	ITEM	MFR	PART NO.
E11	4-3	Contact Board, meter	Singer	OM-1543
E12	4-3	Contact Board, meter	Singer	OM-1543
F1	4-5	Fuse, 115V operation, 3/4 amp	Bussmann	Type MDL
F1	4-5	Fuse, 115V operation, 1-1/2 amp	Bussmann	Type MDL
H1	4-5	Stud (12 required)	Southco	82-11-460-16
H2	4-5	Retainer	Southco	82-32-101-17
J21	4-8	Connector, receptacle	Microdot	31-49
J22	4-8	Connector, phono jack	Lab-Tronics	S-PM-1
J23	4-8	Connector, phono jack	Lab-Tronics	S-PM-1
J24	4-8	Connector, phono jack	Lab-Tronics	S-PM-1
J25	4-8	Connector, phono jack	Lab-Tronics	S-PM-1
J26	4-8	Connector, receptacle	Microdot	31-49
J27	4-8	Cable Assembly	Singer	WA-69
J28	4-8	Cable Assembly	Singer	WA-69
J49	4-6	Connector, receptacle	Viking	VR9/2CE6
J50	4-4	Connector	Amphenol	126-221
J51		Part of W31		
J52	4-6	Connector, coaxial	Microdot	31-49
J53	4-6	Connector, phono jack	Lab-Tronics	S-PM-1
J54	4-6	Connector, phono jack	Lab-Tronics	S-PM-1
J55	4-6	Connector, phono jack	Lab-Tronics	S-PM-1
J56	4-6	Connector, coaxial	Microdot	31-49
J57	4-6	Connector, phono jack	Lab-Tronics	31-49
J58	4-6	Connector, coaxial	Microdot	31-49
J59	4-6	Connector, phono jack	Lab-Tronics	S-PM-1
J60	4-4	Connector, receptacle	Amphenol	26-190-16
J61	4-4	Connector, receptacle	Amphenol	26-190-16
J74		Part of AT1		
J75		Part of W31		
K1	4-7	Relay, coaxial	Dow-Key	DK2-60B BNC
K2	4-7	Relay, coaxial	Dow-Key	DK2-60 BNC
K3	4-7	Relay, coaxial	Dow-Key	DK60-2C BNC

REF DESIG	FIG. NO.	ITEM	MFR	PART NO.
K4	4-8	Relay, 24 vdc	Allied Control	T154-CC-CC
K5	4-8	Relay, 24 vdc	Allied Control	T154-CC-CC
M1	4-3	Meter, tune to max	Singer	MA-20
M2	4-3	Meter, beat	Singer	MA-19
MP1	4-3	Knob	Singer	126-0021-001
MP2	4-3	Knob	Singer	126-0021-001
MP3 thru MP10	4-3	Knob	Singer	126-0021-001
MP11	4-3	Knob	Singer	126-0023-001
MP12	4-3	Knob	Singer	126-0038-001
MP13	4-3	Knob	Singer	126-0036-001
MP14	4-3	Window	Singer	OM-1409
MP15	4-3	Window	Singer	AW-1262
MP16	4-3	Front panel, top	Singer	AW-1259
MP17	4-3	Window	Singer	OM-1515
MP18	4-3	Cover	Singer	AW-1263
MP19		Cover, top	Singer	AA-1227
MP20	4-5	Handle (2 required)	Singer	OM-1511
MP21	4-5	Bracket (6 required)	Singer	OM-1510
MP22	4-6	Shaft and Coupling Assy	Singer	AA-1147
MP23	4-6	Hood, connector	Viking	VS7/23C4
MP24	4-8	Cover	Singer	AA-1243
MP25	4-8	Shield	Singer	OM-1546
MP26	4-8	Tool	Singer	T-150
P7	4-5	Connector, plug	Winchester	MRE34H-1
R1	4-4	Resistor, fixed, composition, 27K ±10%, 1/2W		
R2		Resistor, fixed, composition, 27K ±10%, 1/2W		
R3		Resistor, fixed, composition, 27K ±10%, 1/2W		
R4		Resistor, fixed, composition, 27K ±10%, 1/2W		
R5		Resistor, fixed, composition, 27K ±10%, 1/2W		
R6		Resistor, fixed, composition, 27K ±10%, 1/2W		
R7		Resistor, fixed, composition, 27K ±10%, 1/2W		

REF DESIG	FIG. NO.	ITEM	MFR	PART NO.
R8		Resistor, fixed, composition, 27K ±10%, 1/2W		
R9	4-4	Resistor, fixed, composition, 220K ±10%, 1/2W		
R10	4-4	Resistor, fixed, composition, 220K ±10%, 1/2W		
R11	4-4	Resistor, fixed, composition, 1K ±10%, 1/2W		
R12	4-6	Resistor, fixed, composition, 15K ±10%, 1/2W		
R13	4-8	Resistor, fixed, composition, 10K ±10%, 1/2W		
R14	4-8	Resistor, fixed, composition, 1K ±10%, 1/4W		
R15		Resistor, fixed, composition, 100K ±10%, 1/2W		
S1	4-4	Switch, multiplier	Singer	SW-284
S2	4-4	Switch, frequency mode	Singer	SW-321
S3	4-4	Switch, band select	Singer	SW-231
S4	4-8	Switch, slide	Muter	4603A2
S5 thru S12	4-4	Switch wafer, rotary	Singer	SW-318
W1	4-5	Cable Assy	Belden	1723B
W2		Cable Assy (Accessory)		
W3		Cable Assy (Accessory)		
W4		Cable Assy (Accessory)		
W5	4-6	Cable Assy	Lab-Tronics	S502
W6	4-6	Cable Assy	Lab-Tronics	S502
W7	4-6	Cable Assy	Singer	WA-71
W8	4-7	Cable Assy	Singer	WA-72-2
W9	4-7	Cable Assy	Singer	WA-10-3
W10	4-7	Cable Assy	Singer	WA-78
W11	4-7	Cable Assy	Singer	WA-10-1
W12	4-7	Cable Assy	Singer	WA-10-2
W13	4-5	Cable Assy	Singer	WA-70-1
W14	4-5	Cable Assy	Singer	WA-70-1
W15	4-5	Cable Assy	Singer	WA-70-1
W16	4-5	Cable Assy	Singer	WA-72-1
W17	4-5	Cable Assy	Singer	WA-72-1
W18	4-7	Cable Assy	Singer	WA-72-2

REF DESIG	FIG. NO.	ITEM	MFR	PART NO.
W19	4-7	Cable Assy	Singer	WA-72-3
W20	4-7	Cable Assy	Singer	WA-72-4
W21	4-7	Cable Assy	Singer	WA-72-5
W22	4-7	Cable Assy	Singer	WA-77
W23	4-7	Cable Assy	Singer	WA-70-2
W24	4-6	Cable Assy	Singer	WA-83
W25	4-7	Cable Assy	Lab-Tronics	S501
W26	4-7	Cable Assy	Lab-Tronics	S501
W27	4-7	Cable Assy	Lab-Tronics	S501
W28	4-7	Cable Assy	Lab-Tronics	S501
W29	4-7	Cable Assy	Lab-Tronics	S501
W30	4-7	Cable Assy	Lab-Tronics	S501
W31	4-3	Cable Assy	Singer	WA-75

SECTION V

PHASE LOCK MODULE

REF DESIG	ITEM	MFR	PART NO.
A1	1 CPS Module (See Section VI)	Singer	AA-1167
A2	10 CPS Module (See Section VII)	Singer	AA-1166
A3	100 CPS Module (See Section VII)	Singer	AA-1166
A4	1 KC Module (See Section VII)	Singer	AA-1166
A5	10 KC Module (See Section VIII)	Singer	AA-1165
A6	100 KC Module (See Section IX)	Singer	AA-1164
A7	MC Module (See Section XI)	Singer	AA-1163
A18	3 to 4 MC IF Module (See Section X)	Singer	AA-1189
H1	Key, connector	Viking	091-0024-000
H2	Key, connector	Viking	091-0024-000
H3	Key, connector	Viking	091-0024-000
H4	Key, connector	Viking	091-0024-000
H5	Key, connector	Viking	091-0024-000
H6	Key, connector	Viking	091-0024-000
H7	Key, connector	Viking	091-0024-000
H8	Key, connector	Viking	091-0024-000
H9	Cover	Singer	AS-1190
H10	Catch and Strike (2)	Nielson	VHC340-2
J64	Connector	Viking	2VH15/1AB8
J65	Connector	Viking	2VH15/1AB8
J66	Connector	Viking	2VH15/1AB8
J67	Connector	Viking	2VH15/1AB8
J68	Connector	Viking	2VH15/1AB8
J69	Connector	Viking	2VH15/1AB8
J70	Connector	Viking	2VH15/1AB8
J71	Connector	Viking	2VH15/1AB8

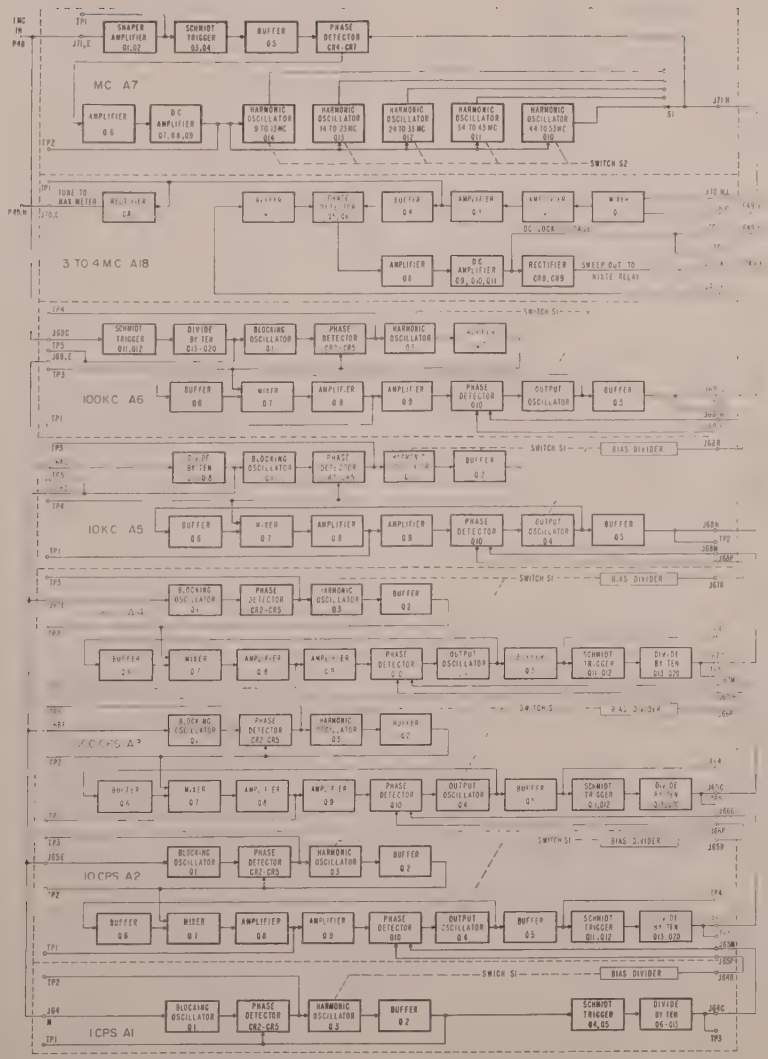


Figure 5-1. Block Diagram

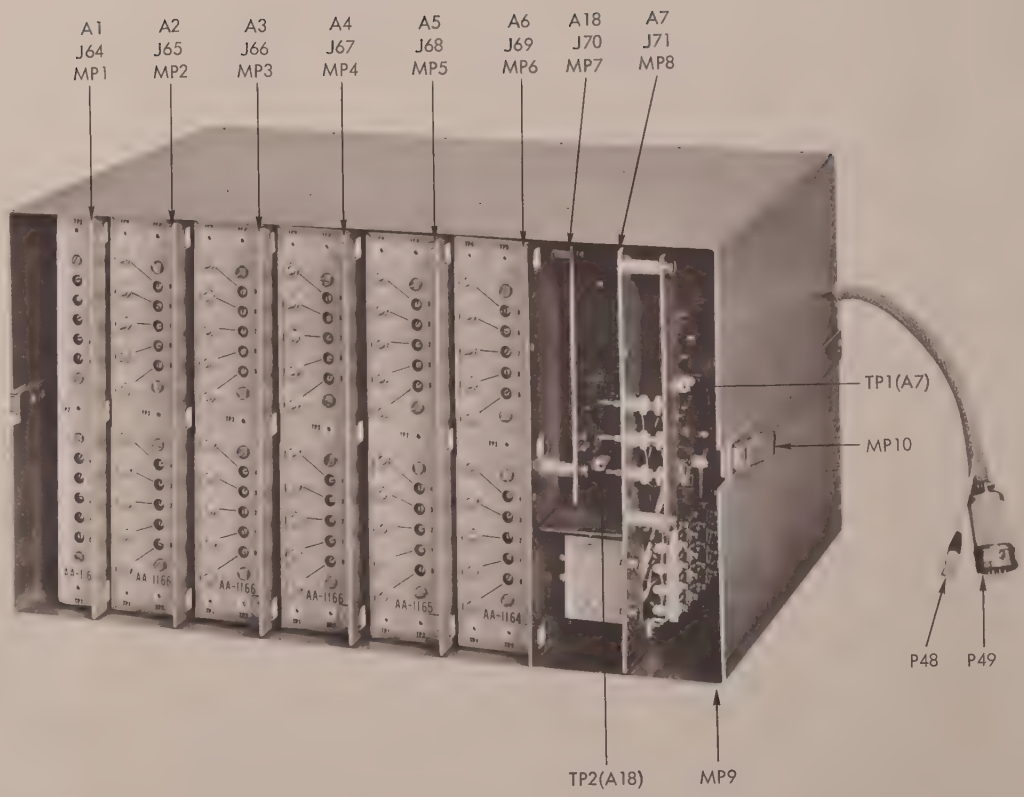


Figure 5-2. Parts Location

5-1. GENERAL.

5-2. This section contains general information covering the phase lock system. For detail information on the various sub-modules, refer to the following sections:

a. 1 cps Module A1, see Section VI.

b. 10 cps Module A2, see Section VII.

c. 100 cps Module A3, see Section VII.

d. 1 KC Module A4, see Section VII.

e. 10 KC Module A5, see Section VIII.

f. 100 KC Module A6, see Section IX.

g. 3 to 4 MC Module A18, see Section X.

h. MC Module A7, see Section XI.

5-3. CIRCUIT DESCRIPTION. (See figure 5-1.)

5-4. The phase lock system produces a dc voltage which locks the HFO to an exact frequency. This dc voltage is applied to a capacitor element in the HFO tank circuit and operates as a tuning voltage.

5-5. The two major elements of the phase lock system are the harmonic oscillator of the MC module A7 and the synthesizer composed of modules A1 through A6. One of five harmonic oscillators is selected by the 10 MC switch S2(A7) and the oscillator is set to frequency by the 1 MC switch S1(A7). The outputs of the harmonic oscillator and the HFO are applied to mixer Q1 of 3 to 4 MC module.

5-6. The difference frequency is between 3 and 4 MC and is applied to the phase detector Q5, Q6. The synthesizer varies in 1 cps steps from 4 to 3 MC and this frequency is applied to the other side of the phase detector. When the two frequencies are exactly equal, the phase detector produces a steady dc voltage. If either frequency varies, the dc voltage varies and this in turn results in a retuning of the HFO.

5-7. TEST EQUIPMENT.

5-8. Refer to Table 5-1 for a list of test equipment.

5-9. CHECKOUT.

5-10. To checkout the synthesizer, proceed as follows:

a. Set FREQUENCY MODE switch to SET UP or LOCK.

b. Connect counter to TP5 of 100 KC module A6.

c. The divider output shall be 100 KC ±1 cps.

d. Connect counter to TP5 of 10 KC module A5.

e. The divider output shall be 10 KC ±1 cps.

f. Connect counter to TP3 of 1 cps module A1.

g. Vary 1 cps switch from 0 to 9.

h. The output of the 1 cps module shall vary from 30 to 39 KC in 1 KC steps (±1 cps).

i. Connect counter to TP5 of 10 cps module A2.

j. Set all decade switches to 0.

k. Vary 10 cps switch from 0 to 9.

l. The output of the 10 cps module shall vary from 30 to 39 KC in 1 KC steps (±1 cps).

m. Connect counter to TP5 of 100 cps module A3.

n. Set all decade switches to 0.

o. Vary 100 cps switch from 0 to 9.

p. The output of the 100 cps module shall vary from 30 to 39 KC in 1 KC steps (±1 cps).

q. Connect counter to TP5 of 1 KC module A4.

r. Set all decade switches to 0.

s. Vary 1 KC switch from 0 to 9.

t. The output of the 1 KC module shall vary from 30 to 39 KC in 1 KC steps (±1 cps).

u. Connect counter to TP2 of 10 KC module A5.

v. Set all decade switches to 0.

w. Vary 10 KC switch from 0 to 9.

TABLE 5-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Counter	0 to 4 MC	
Frequency Meter	9 to 53 MC measuring range	
VTVM	1 to 14 vdc range	

x. The output of the 10 KC module shall vary from 300 to 390 KC in 10 KC steps (±1 cps).

y. Connect counter to TP2 of 100 KC module A6.

z. Set all decade switches to 0.

aa. Vary 100 KC switch from 0 to 9.

ab. The output of the 100 KC module shall vary from 4.0 MC (switch at 0) to 3.1 MC (switch at 9) in 100 KC steps (±1 cps).

5-11. To checkout the harmonic oscillator module A7, proceed as follows:

a. Connect frequency meter to pin H of connector J11 (megacycle module A7). To gain access to pin, use circuit board extender 1866.

b. Set FREQUENCY MODE switch to SET UP or LOCK.

c. Set all decade switches to 0.

d. Vary the load 10 MC switches from 0 to 49 MC in 1 MC steps.

e. In the 0 to 4 MC range, the measured output shall equal the setting of the switches plus 12 MC (with a setting of 01, the output shall be 13 MC).

f. In the 5 to 49 MC range, the measured output shall equal the setting of the switches plus 4 MC (with a setting of 25, the output shall be 29 MC).

NOTE

Since all frequencies are exact multiples of 1 MC, the output may be checked with an oscilloscope and the 1 MC output. A steady Lissajous pattern indicates lock and frequency may be checked by counting sine waves against the 1 MC time base.

5-12. To checkout the 3 to 4 MC module A18, proceed as follows:

a. Connect VTVM to TP2 of module A18. To gain access to test point, use circuit board extender 1865.

b. Set FREQUENCY MODE switch to SET UP.

c. Set decade switches to 5.5 MC.

d. Set BAND SELECT switch to 5-8.

e. Set FREQUENCY control to approximately 5.5 MC and check that a maximum indication can be obtained on the TUNE-TO-MAX meter.

f. Check that TP2 indicates a steady dc voltage of approximately 11 vdc.

g. Set frequency control to 6.5 MC.

h. Check that TP2 indicates a dc voltage that varies from approximately 6 to 14 vdc.

TABLE 5-2. KEY TO TEST POINTS

MODULE	TEST POINT		NORMAL INDICATION
A1, 1 CPS	TP1	Harmonic Oscillator	Varies from 300 to 390 KC in 10 KC steps (300 KC with S1 at 0).
	TP2	Phase Detector	2.5 ±0.5 vdc
	TP3	Divider	Varies from 30 to 39 KC in 1 KC steps (30 KC with S1 at 0).
A2, 10 CPS	TP1	Mixer	Varies from 30 to 39 KC in 1 KC steps (30 KC with all switches at 0).
	TP2	Harmonic Oscillator	Varies from 270 to 360 KC in 10 KC steps (270 KC with S1 at 0).
	TP3	Phase Detector	4.0 ±0.5 vdc
	TP4	Output Oscillator	Varies from 300 to 399 KC in 1 KC steps (300 KC with all switches at 0).
	TP5	Divider	Varies from 30 to 39.9 KC in 0.1 KC steps (30 KC with all switches at 0).

TABLE 5-2. KEY TO TEST POINTS (CONT)

MODULE	TEST POINT		NORMAL INDICATION
A3, 100 CPS	TP1	Mixer	Varies from 30 to 39.9 KC in 0.1 KC steps (30 KC with all switches at 0).
	TP2	Harmonic Oscillator	Varies from 270 to 360 KC in 10 KC steps (270 KC with S1 at 0).
	TP3	Phase Detector	4.0 ±0.5 vdc
	TP4	Output Oscillator	Varies from 300 to 399.9 KC in 0.1 KC steps (300 KC with all switches at 0).
	TP5	Divider	Varies from 30 to 39.99 KC in 0.01 KC steps (30 KC with all switches at 0).
A4, 1 KC	TP1	Mixer	Varies from 30 to 39.99 KC in 0.01 KC steps (30 KC with all switches at 0).
	TP2	Harmonic Oscillator	Varies from 270 to 360 KC in 10 KC steps (270 KC with S1 at 0).
	TP3	Phase Detector	4.0 ±0.5 vdc
	TP4	Output Oscillator	Varies from 300 to 399.99 KC in 0.01 KC steps (300 KC with all switches at 0).
	TP5	Divider	Varies from 30 to 39.999 KC in 0.001 KC steps (30 KC with all switches at 0).
A5, 10 KC	TP1	Mixer	Varies from 30 to 39.999 KC in 0.001 KC steps (30 KC with all switches at 0).
	TP2	Output Oscillator	Varies from 300 to 399.999 KC in 0.001 KC steps (300 KC with all switches at 0).
	TP3	Phase Detector	3.5 ±0.5 vdc
	TP4	Harmonic Oscillator	Varies from 270 to 360 KC in 10 KC steps (270 KC with S1 at 0).
	TP5	Divider	10 KC
A6, 100 KC	TP1	Mixer	Varies from 300 to 399.999 KC in 0.001 KC steps (300 KC with all switches at 0).
	TP2	Output Oscillator	Varies from 4.0 to 3.000001 MC in 0.000001 MC steps (4.0 MC with all switches at 0).
	TP3	Harmonic Oscillator	Varies from 4.3 to 3.4 MC in 0.1 MC steps (4.3 MC with S1 at 0).
	TP4	Phase Detector	4.0 ±0.5 vdc
	TP5	Divider	100 KC
A18, 3 to 4 MC, IF	TP1	Mixer	Varies from 4.0 to 3.000001 MC in .000001 MC steps (4.0 MC with all switches at 0).
A7, MC	TP2	DC Amplifier	Steady dc voltage of approximately 11 vdc. Varies when lock is lost from approximately 6 to 14 vdc.

SECTION VI

1 CPS MODULE
A1

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mica, 270 pf ±5%	Elmenco	DM15E271J
C2	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C3	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C4	Capacitor, mica, 820 pf ±5%	Elmenco	DM15E821J
C5	Capacitor, mica, 820 pf ±5%	Elmenco	DM15E821J
C6	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C7	Capacitor, disc, 200 pf ±5%, N750	Sprague	10TCU-T20
C8	Capacitor, mica, 270 pf ±5%	Elmenco	DM15E271J
C9	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C10	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C11	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C12	Capacitor, electrolytic, 47 uf ±20%	Goodall	931-47-25-20
C13	Capacitor, mica, 390 pf ±5%	Elmenco	DM15E391J
C14	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C15	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C16	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C17	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C18	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C19	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C20	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C21	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C22	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C23	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C24	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C25	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C26	Not used		
C27	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C28	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C29	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C30	Capacitor, electrolytic, 22 uf, 6V	Goodall	931-22-6-20
C31	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C32	Capacitor, mica, 430 pf ±5%	Elmenco	DM15E431J
C33	Capacitor, mica, 360 pf ±5% (nominal value)	Elmenco	DM15E361J
C34	Capacitor, mica, 270 pf ±5%	Elmenco	DM15E271J
C35	Capacitor, mica, 200 pf ±5%	Elmenco	DM15E201J
C36	Capacitor, mica, 150 pf ±5%	Elmenco	DM15E151J
C37	Capacitor, mica, 120 pf ±5%	Elmenco	DM15E121J
C38	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C39	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C40	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C41	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C42	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C43	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C44	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C45	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C46	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C47	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C48	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C49	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C50	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
CR1	Diode	Texas Instr	1N914
CR2	Diode	Texas Instr	1N914
CR3	Diode	Texas Instr	1N914
CR4	Diode	Texas Instr	1N914
CR5	Diode	Texas Instr	1N914
CR6	Diode, capacitive reactance	Philco	V4090
CR7	Diode	Texas Instr	1N914
CR8	Diode	Texas Instr	1N914
CR9	Diode	Texas Instr	1N914
CR10	Diode	Texas Instr	1N914
CR11	Diode	Texas Instr	1N914
CR12	Diode	Texas Instr	1N914

(continued on page 6-8)

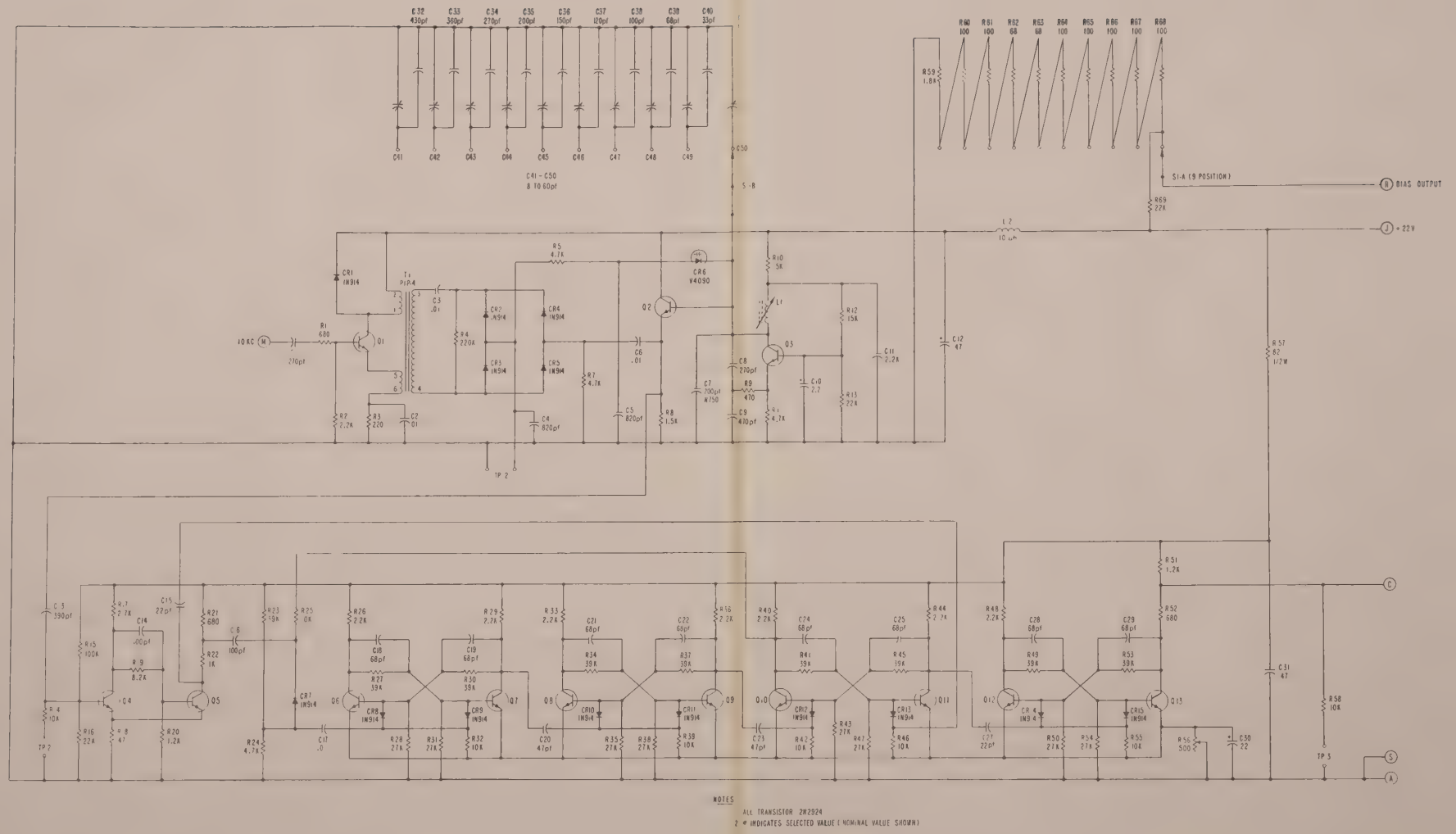


Figure 6-1. Schematic Diagram

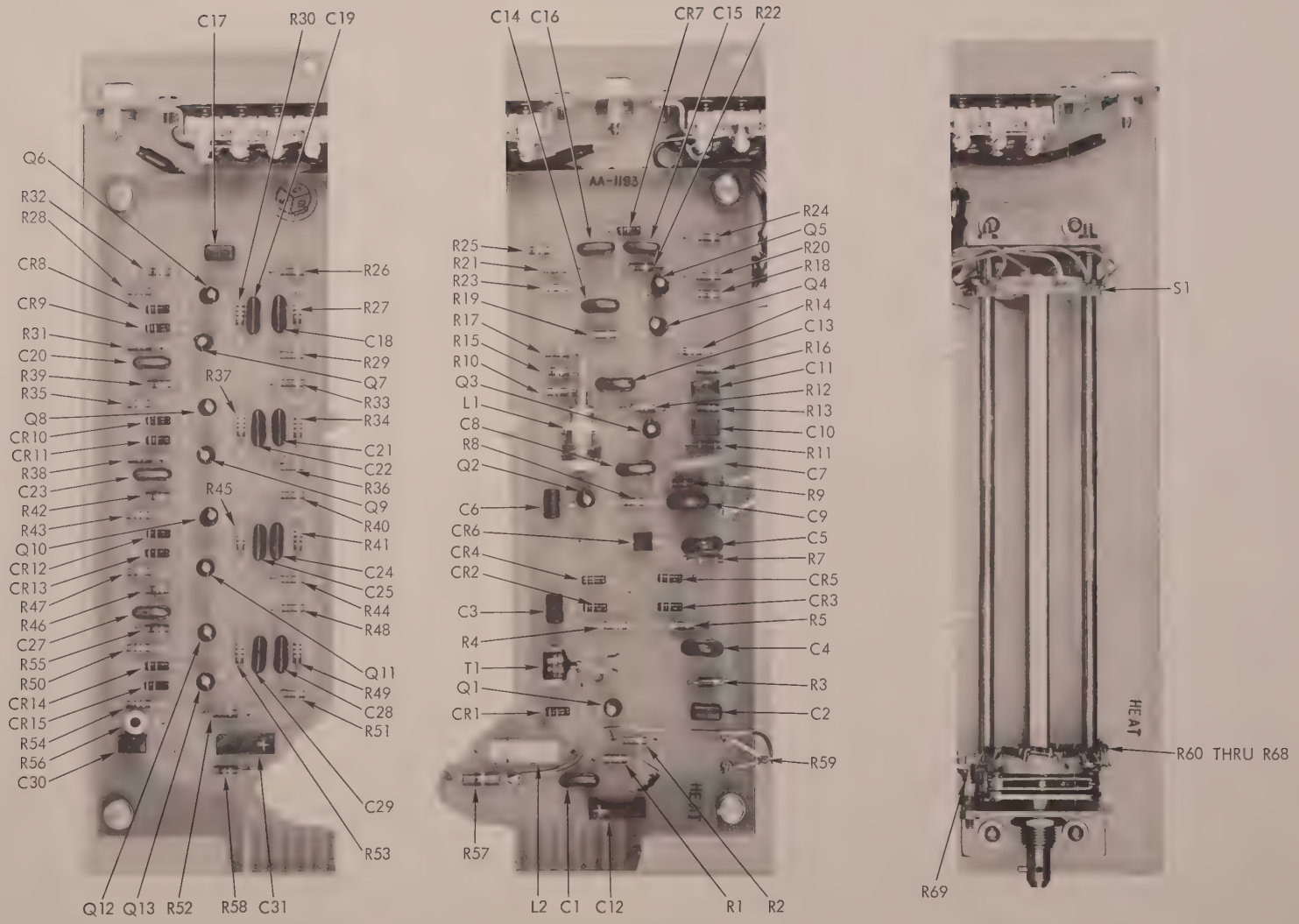


Figure 6-2. Parts Location (Sheet 1 of 2)

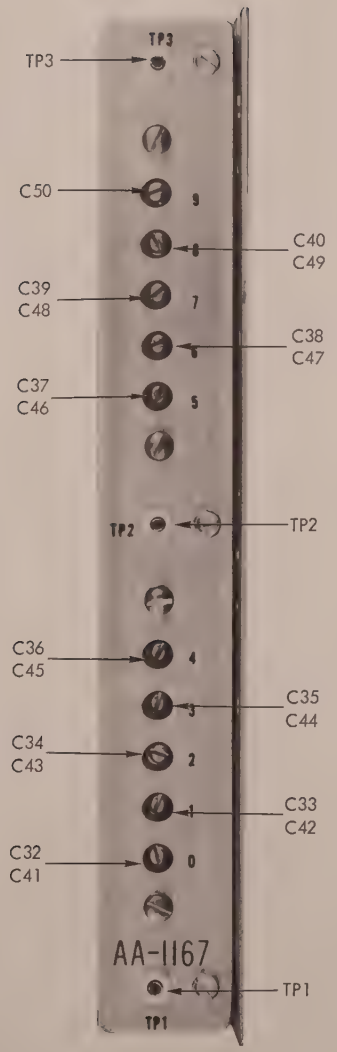


Figure 6-2. Parts Location (Sheet 2 of 2)

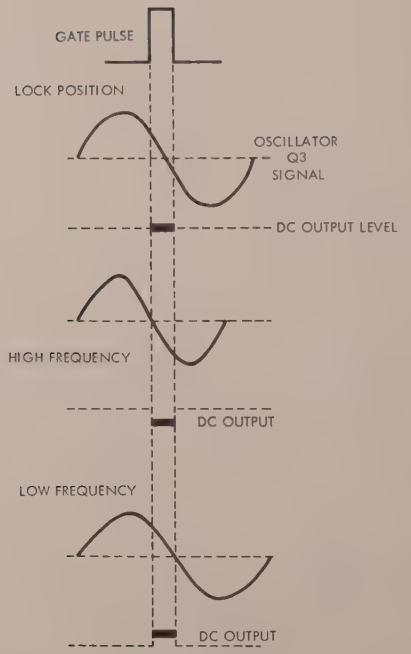


Figure 6-3. Phase Lock Bridge Waveforms

6-1. CIRCUIT DESCRIPTION.

6-2. The 1 cps module receives a 10 KC signal from the divider of the 10 KC module A5 and delivers a 30 to 39 KC signal to the 10 cps module A2. The module also delivers a bias voltage to the 10 cps module.

6-3. Harmonic oscillator Q3 is a common base, L-C oscillator which produces a 300 to 390 KC signal. The oscillator is tuned to exact 10 KC increments in a two-step tuning process. Switch S1 rough tunes the oscillator to a 10 KC increment by selection of tank capacitors. A phase-lock loop, operating through capacitive reactance diode CR6, tunes the oscillator to an exact harmonic of 10 KC. The diode is voltage sensitive and is controlled by the dc voltage from the phase detector.

6-4. The oscillator output signal is delivered to the 10 cps module through buffer Q2, Schmitt trigger Q4 and Q5, and the divide-by-ten circuit Q6 through Q13. The Schmitt trigger converts the oscillator signal to trigger pulses for the flip-flop divider. The divider is a standard four-stage divider which is converted to a divide-by-ten circuit by gate pulses.

6-5. Blocking oscillator Q1 converts the 10 KC input signal to a gate pulse which is applied to diodes CR2 through CR5. When the pulse is applied, all four diodes conduct and apply a portion of the signal from buffer Q2 to diode CR6. This signal is referenced to a dc level by voltage dividers R7 and R8 and effectively filtered by an RC network.

6-6. As shown in figure 6-3, the dc output level is determined by the phase relations between the gate pulse and the oscillator signal. If the oscillator drifts from an exact multiple of 10 KC, the phase relations change and produce a change in dc output. The change in dc output changes the effective capacitance of the reactance diode and automatically corrects the frequency drift.

6-7. Resistors R59 through R68 provide a voltage divider network. Switch S1 selects a dc voltage equivalent to the selected frequency and this voltage is supplied to the subsequent stage as a bias voltage.

6-8. TEST EQUIPMENT.

6-9. Refer to Table 6-1 for a list of test equipment.

6-10. ADJUSTMENTS.

6-11. Adjust circuits as follows:

a. Connect counter to TP5 of 10 KC module A5. Make certain that a 10 KC locking signal is present.

b. Connect counter to TP1 of 1 cps module A1.

c. Check that oscillator frequency is 300 KC ±1 cps. If necessary, adjust capacitor C41 to obtain output.

d. Repeat step c for the following switch positions:

SWITCH POSITION	CAPACITOR	FREQUENCY
0	C41	300 KC
1	C42	310 KC
2	C43	320 KC
3	C44	330 KC
4	C45	340 KC
5	C46	350 KC
6	C47	360 KC
7	C48	370 KC
8	C49	380 KC
9	C50	390 KC

e. If necessary, adjust coil L1 to obtain best compromise for all switch positions.

f. Connect counter to TP3.

g. Connect VTVM to the emitter of Q13.

h. Set switch to position 9.

i. Check that output frequency is 39 KC.

j. Vary resistor R56 until lock is lost (output frequency varies from 39 KC ±1 cps). Note maximum and minimum lock voltage and set R56 to approximately the midpoint of the lock voltage range.

TABLE 6-1. TEST EQUIPMENT

ITEM	RANGE	ADJUSTMENT	TROUBLE SHOOTING	NOTES
VTVM (HP-534)	1 to 10 vdc	✓	✓	
	1 to 22 vdc		✓	
Oscilloscope (Tektronix 545A)	30 to 40 KC, 5 to 10V p-p	✓	✓	A scope with a vertical signal output and a high impedance probe is recommended.

TABLE 6-1. TEST EQUIPMENT (CONT)

ITEM	RANGE	ADJUSTMENT	TROUBLE SHOOTING	NOTES
Oscilloscope (cont)	300 to 400 KC, 1 to 10V p-p		✓	
Counter	30 to 40 KC	✓	✓	If the counter has a low impedance probe, connect to the vertical signal output of the scope or through a high impedance probe.
	300 to 400 KC		✓	
	10 KC	✓		
Board Extender (Singer Model 1865)				

TABLE 6-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Emitter voltage should be within ±.5 vdc of base voltage.

c. Supply voltage of 22.0 vdc

TRANSISTOR	BASE	COLLECTOR	TRANSISTOR	BASE	COLLECTOR
Q1	14.5	19.8	Q8	3.4	13.5
Q2	13	20	Q9	4.2	11
Q3	6.8	13.5	Q10	5	8.2
Q4	-2.3	7	Q11	1.95	16.5
Q5	.62	7.4	Q12	4	14
Q6	3	13.5	Q13	4.6	11.5
Q7	6.2	11			

TABLE 6-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	Pin J, J64	VTVM	+22 vdc ±1 vdc	
2. 10 KC Input	Pin M, J64	Scope	Square wave, 7 ±1V peak-to-peak	
3. Oscillator Output	TP1	Counter	300 to 390 KC	Frequency set by 1 cps switch. 0 = 300, 1 = 310, 2 = 320 KC, etc.
		Scope	Sine wave	Approximately 6V peak-to-peak.
4. Divider Output	TP3	Counter	30 to 39 KC	See adjustment procedure.

TABLE 6-3. DYNAMIC MEASUREMENTS (CONT)

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
4. Divider Output (cont)		Scope	Rounded square wave. 6 to 8V peak-to-peak.	See adjustment procedure.
5. Phase Detector Output	TP2	VTVM	-4.6 to +3.6 vdc (approximate lock range)	Varying dc voltage indicates lack of lock.
6. Bias Output	Pin R	VTVM	1.6 to 2.4 vdc	Varies in 0.1V steps.

REF DESIG	ITEM	MFR	PART NO.
CR13	Diode	Texas Instr	1N914
CR14	Diode	Texas Instr	1N914
CR15	Diode	Texas Instr	1N914
L1	Inductor, variable	Singer	LR 25-2
L2	Inductor, 10 uh	Delevan	2500-76
Q1	Transistor	GE	2N2924
Q2	Transistor	GE	2N2924
Q3	Transistor	GE	2N2924
Q4	Transistor	GE	2N2924
Q5	Transistor	GE	2N2924
Q6	Transistor	GE	2N2924
Q7	Transistor	GE	2N2924
Q8	Transistor	GE	2N2924
Q9	Transistor	GE	2N2924
Q10	Transistor	GE	2N2924
Q11	Transistor	GE	2N2924
Q12	Transistor	GE	2N2924
Q13	Transistor	GE	2N2924
R1	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R3	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		
R4	Resistor, fixed, composition, 220K ±10%, 1/4W		
R5	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R6	Not used		
R7	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R8	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R9	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R10	Resistor, fixed, composition, 10K ±10%, 1/4W		
R11	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R12	Resistor, fixed, composition, 15K ±10%, 1/4W		
R13	Resistor, fixed, composition, 22K ±10%, 1/4W		
R14	Resistor, fixed, composition, 10K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R15	Resistor, fixed, composition, 100K ±10%, 1/4W		
R16	Resistor, fixed, composition, 22K ±10%, 1/4W		
R17	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R18	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R19	Resistor, fixed, composition, 8.2K ±10%, 1/4W		
R20	Resistor, fixed, composition, 1.2K ±10%, 1/4W		
R21	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R22	Resistor, fixed, composition, 1K ±10%, 1/4W		
R23	Resistor, fixed, composition, 3.9K ±10%, 1/4W		
R24	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R25	Resistor, fixed, composition, 10K ±10%, 1/4W		
R26	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R27	Resistor, fixed, composition, 39K ±10%, 1/4W		
R28	Resistor, fixed, composition, 27K ±10%, 1/4W		
R29	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R30	Resistor, fixed, composition, 39K ±10%, 1/4W		
R31	Resistor, fixed, composition, 27K ±10%, 1/4W		
R32	Resistor, fixed, composition, 10K ±10%, 1/4W		
R33	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R34	Resistor, fixed, composition, 39K ±10%, 1/4W		
R35	Resistor, fixed, composition, 27K ±10%, 1/4W		
R36	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R37	Resistor, fixed, composition, 39K ±10%, 1/4W		
R38	Resistor, fixed, composition, 27K ±10%, 1/4W		
R39	Resistor, fixed, composition, 10K ±10%, 1/4W		
R40	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R41	Resistor, fixed, composition, 39K ±10%, 1/4W		
R42	Resistor, fixed, composition, 10K ±10%, 1/4W		
R43	Resistor, fixed, composition, 27K ±10%, 1/4W		
R44	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R45	Resistor, fixed, composition, 39K ±10%, 1/4W		
R46	Resistor, fixed, composition, 10K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R47	Resistor, fixed, composition, 27K ±10%, 1/4W		
R48	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R49	Resistor, fixed, composition, 39K ±10%, 1/4W		
R50	Resistor, fixed, composition, 27K ±10%, 1/4W		
R51	Resistor, fixed, composition, 1.2K ±10%, 1/4W		
R52	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R53	Resistor, fixed, composition, 39K ±10%, 1/4W		
R54	Resistor, fixed, composition, 27K ±10%, 1/4W		
R55	Resistor, fixed, composition, 10K ±10%, 1/4W		
R56	Resistor, variable, 500 ohms, Helitrim	Beckman	62P-R500
R57	Resistor, fixed, composition, 82 ohms, 1/2W		
R58	Resistor, fixed, composition, 10K ±10%, 1/4W		
R59	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R60	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R61	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R62	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R63	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R64	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R65	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R66	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R67	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R68	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R69	Resistor, fixed, composition, 22K ±10%, 1/4W		
S1	Switch	Singer	OM-1496-2
T1	Transformer	UTC	PIP-4
TP1	Test Point	Sealectro	SKT-5BC
TP2	Test Point	Sealectro	SKT-5BC
TP3	Test Point	Sealectro	SKT-5BC

SECTION VII

10 CPS MODULE A2
100 CPS MODULE A3
1 KC MODULE A4

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mica, 270 pf ±5%	Elmenco	DM15E271J
C2	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C3	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C4	Capacitor, mica, 820 pf ±5%	Elmenco	DM15E821J
C5	Capacitor, mica, 820 pf ±5%	Elmenco	DM15E821J
C6	Capacitor, mylar, 0.01 uf ±10%, 50V (located on back of board)	Paktron	MR330-.01
C7	Capacitor, N750, 200 pf ±5%	Sprague	2515
C8	Capacitor, mica, 270 pf ±5%	Elmenco	DM15E271J
C9	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C10	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C11	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C12	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C13	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C14	Capacitor, N1500, 470 pf ±5%	Centralab	TB63-471K23L
C15	Capacitor, mylar, 0.1 uf, 50V	Paktron	MR700-.1
C16	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C17	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C18	Capacitor, disc, 0.005 uf ±5%	Sprague	851Z5U.005
C19	Capacitor, mica, 1000 pf ±5%	Elmenco	DM19E102J
C20	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C21	Capacitor, disc, 0.005 uf ±5%	Sprague	851Z5U.005
C22	Capacitor, mica, 1000 pf ±5%	Elmenco	DM19E102J
C23	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C24	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C25	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C26	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C27	Capacitor, mica, 390 pf ±5%	Elmenco	DM15E391J
C28	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C29	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C30	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C31	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C32	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C33	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C34	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C35	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C36	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C37	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C38	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C39	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C40	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C41	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C42	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C43	Capacitor, electrolytic, 22 uf, 6V	Goodall	931-22-6-20
C44	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C45	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C46	Capacitor, mica, 390 pf ±5%	Elmenco	DM15E391J
C47	Capacitor, mica, 330 pf ±5%	Elmenco	DM15E331J
C48	Capacitor, mica, 250 pf ±5%	Elmenco	DM15E251J
C49	Capacitor, mica, 200 pf ±5%	Elmenco	DM15E201J
C50	Capacitor, mica, 150 pf ±5%	Elmenco	DM15E151J
C51	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C52	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C53	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C54	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C55	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C56	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C57	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C58	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C59	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C60	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C61	Capacitor, trimmer, 8 to 60 pf	Elmenco	404

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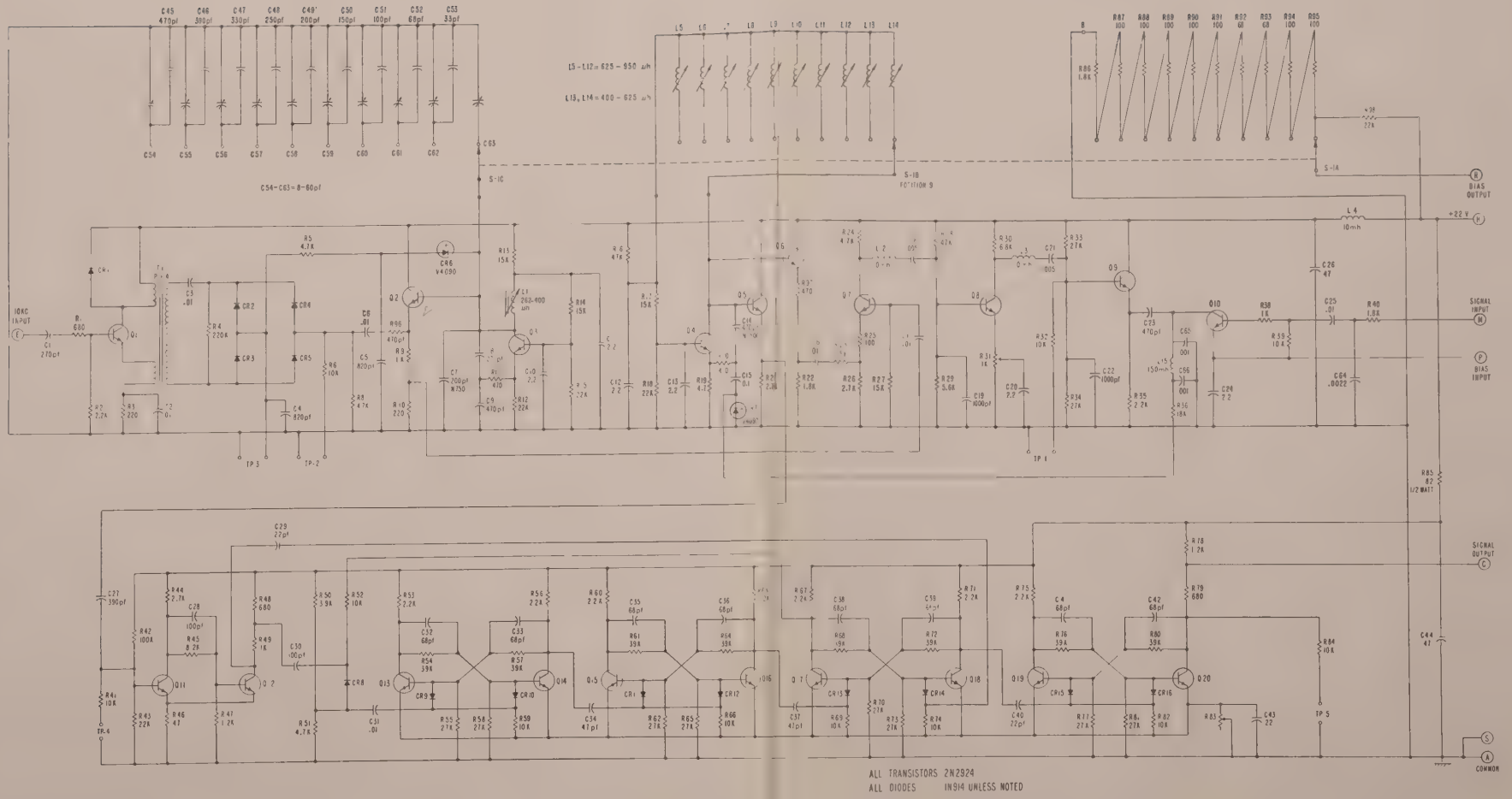


Figure 7-1. Schematic Diagram

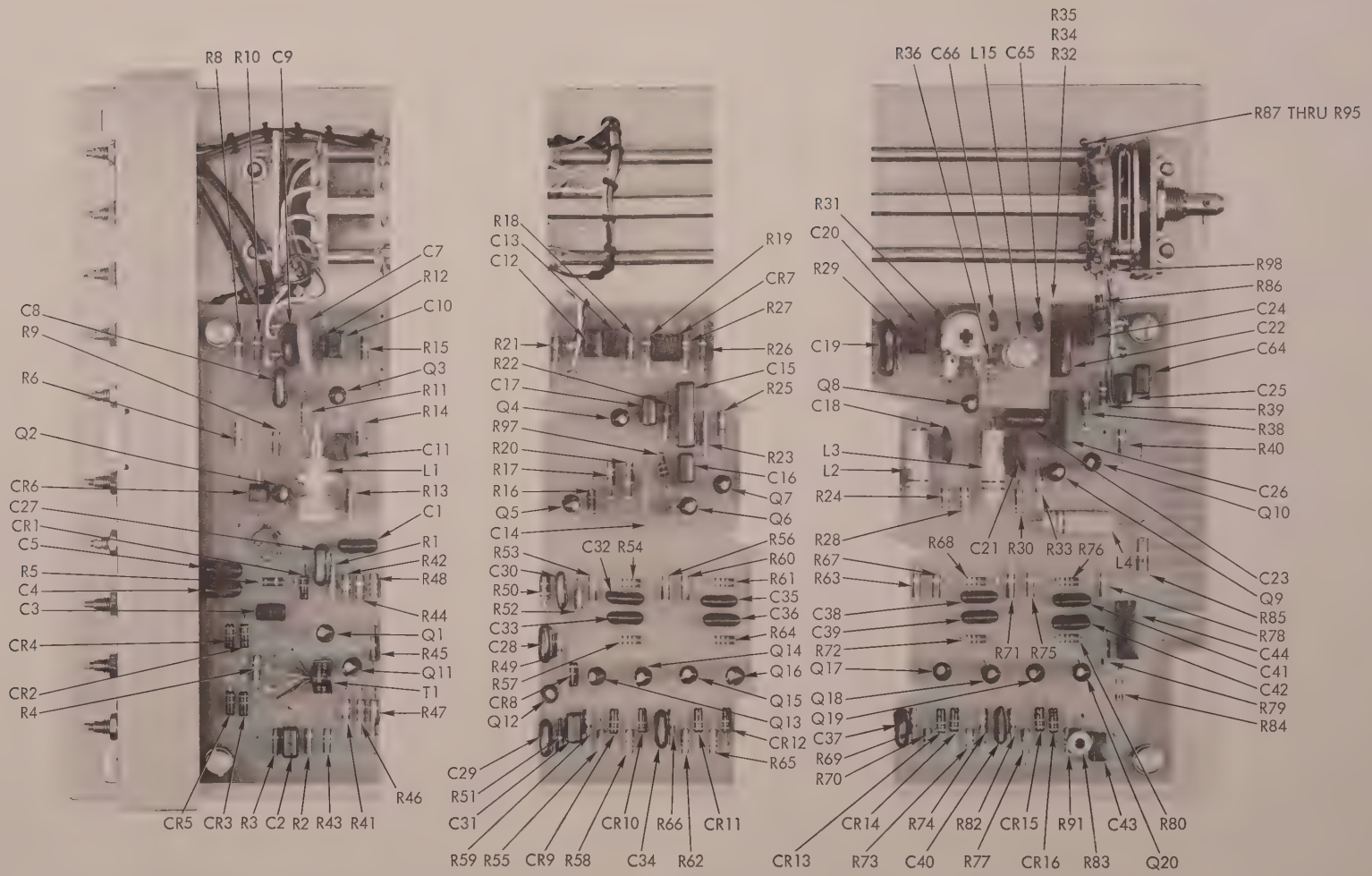


Figure 7-2. Parts Location (Sheet 1 of 2)

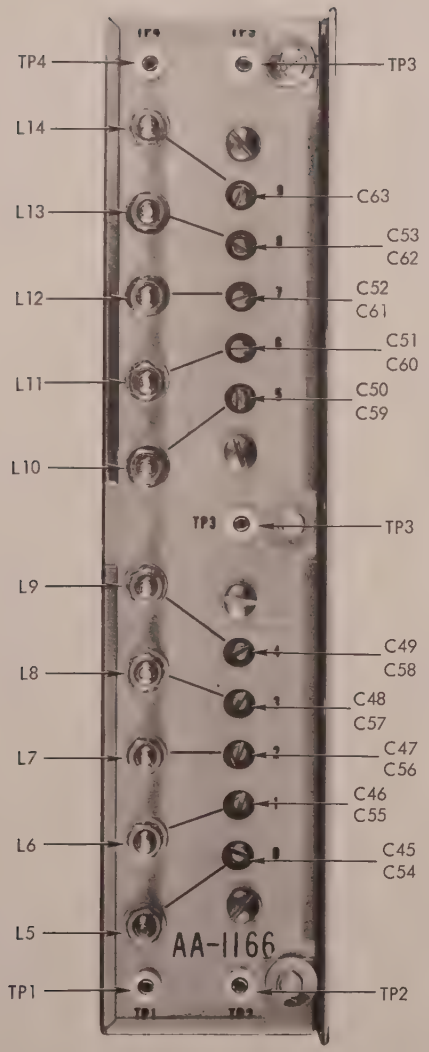


Figure 7-2. Parts Location (Sheet 2 of 2)

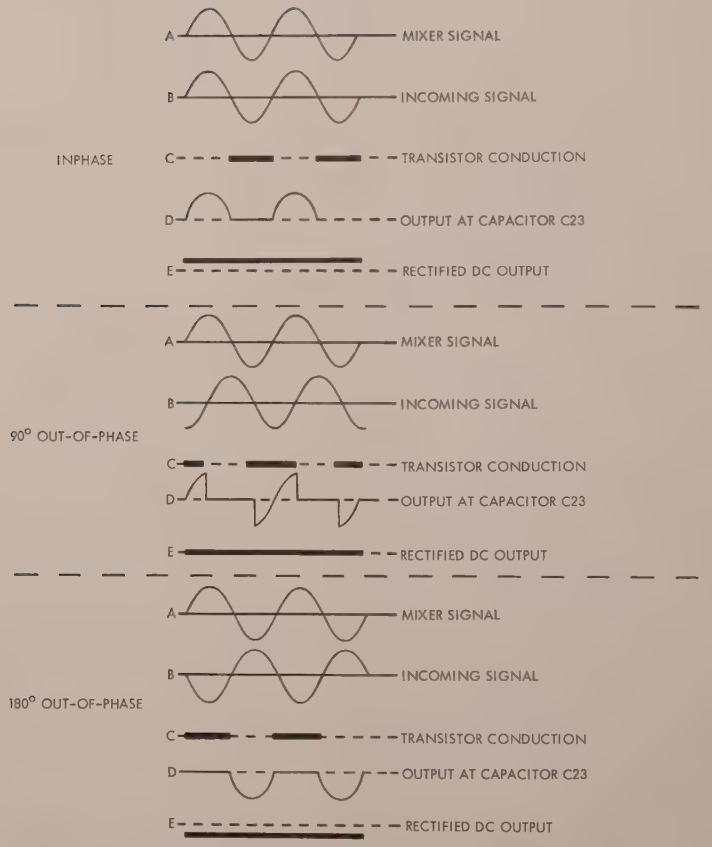


Figure 7-3. Phase Detector Waveforms

7-1. CIRCUIT DESCRIPTION.

7-2. The 10 cps module receives a 10 KC signal from the divider of the 10 KC module A5 and a 30 to 39 KC from the 1 cps module A1. The 10 cps module delivers a 30 to 39.9 KC signal to the 100 cps module A3. The 100 cps module delivers a 30 to 39.99 KC signal to the 1 KC module A4. The 1 KC module delivers a 30 to 39.999 KC signal to the 10 KC module A5. These modules also deliver a bias voltage to the following modules.

7-3. The harmonic oscillator Q3, buffer Q2, and blocking oscillator Q1 operate in the same manner as for the 1 cps module (see paragraphs 6-3, 6-5, and 6-6).

7-4. The signal from the harmonic oscillator Q3 and the signal from the preceding module are combined and form the lock frequency for output oscillator Q4. This oscillator is set to approximate frequency by selection of a pretuned tank coil and set to exact frequency by a phase-lock loop.

7-5. The signal from harmonic oscillator Q3 is applied to the base of mixer Q7. The signal from output oscillator Q4 is applied through buffer Q6 to the emitter of the mixer. The mixer produces the difference frequency which is applied to the phase detector Q10 through amplifiers Q8 and Q9. The signal level to the phase detector is set by resistor R31. Noise and harmonics are eliminated from the signal by the series tuned circuits in the output of mixer Q7 and amplifier Q8.

7-6. The difference frequency from the mixer is compared to the signal from the preceding module in phase detector Q10. When the two signals have exactly the same frequency, the output of the phase detector is a steady dc voltage. This voltage is applied to the reactance diode CR7 of the output oscillator tank circuit.

7-8. The signal and the bias voltage from the preceding module are applied to transistor Q10. Through resistors R38 and R39, the base and emitter of the transistor are set to the same dc level. The transistor therefore operates as a half wave switching circuit. During a half cycle of the incoming signal, the transistor conducts and short circuits any signal appearing at capacitor C23 to ground. During the alternate half cycle, the transistor is cutoff and the signal at capacitor C23 is applied through to diode CR7.

7-9. The amplitude of the average dc voltage output is determined by the phase relationship of the two incoming signals (see figure 7-3). When the two signals are exactly inphase, the output is a maximum positive voltage. At 90° out-of-phase, the output is zero and, at 180° out-of-phase, the output is a maximum negative voltage. When the two signals are inphase, transistor Q10 shorts the negative half of the mixer signal to ground and the output to diode CR7 has an average plus value.

7-10. As long as the phase relations of the two input signals remain constant, the output of the phase detector is a steady dc voltage. The phase relations remain constant only when the two signals have exactly the same frequency. When the two signals vary in frequency, the phase relations change over a given length of time and the output is a slowly varying dc voltage. Figure 7-4 shows the phase detector waveforms and output for a difference in frequency. The frequency of the varying dc voltage is equal to the difference in frequency between the two input signals.

7-11. The signal from the preceding module may vary over a 10 KC range (30 to 40 KC). To assist in locating and maintaining the dc lock voltage, the bias voltage from the preceding module is applied to the phase detector. This bias voltage is approximately equivalent to the incoming frequency and sets the dc reference level of the phase detector.

7-12. The signal from the output oscillator Q4 is applied to the succeeding module through buffer Q5, Schmitt trigger Q11 and Q12, and the divide-by-ten circuit Q13 through Q20. The Schmitt trigger converts the oscillator signal to trigger pulses for the flip-flop divider. The divider is a standard four-stage divider which is converted to a divide-by-ten circuit by gate pulses.

7-13. Resistors R86 through R95 provide the bias network for the succeeding stage.

7-14. TEST EQUIPMENT.

7-15. Refer to Table 7-1 for a list of test equipment.

7-16. ADJUSTMENTS.

7-17. Adjust harmonic oscillator circuits as follows:

a. Connect counter to TP5 of 10 KC module A5. Make certain that a 10 KC locking signal is present.

b. Connect counter to TP2 of module under test (harmonic oscillator output).

c. Set selector switch for module under test to 0.

d. Check that harmonic oscillator signal is 270 KC ±1 cps. If necessary, adjust capacitor C54 to obtain output.

e. Repeat step d for the following switch positions:

SWITCH POSITION	CAPACITOR	FREQUENCY
0	C54	270 KC
1	C55	280 KC
2	C56	290 KC
3	C57	300 KC
4	C58	310 KC
5	C59	320 KC
6	C60	330 KC
7	C61	340 KC
8	C62	350 KC
9	C63	360 KC

TABLE 7-1. TEST EQUIPMENT

ITEM	RANGE	ADJUSTMENT	TROUBLE SHOOTING	NOTES
VTVM	1 to 22 vdc	✓	✓	
Oscilloscope (Tektronix 545A)	30 to 40 KC 5 to 20V p-p	✓	✓	A scope with a vertical signal output and a high impedance probe is recommended.
	300 to 400 KC 1 to 20V p-p	✓	✓	
Counter	10 KC	✓		If the counter has a low impedance probe, connect to the vertical signal output of the scope or through a high impedance probe.
	30 to 40 KC	✓	✓	
	300 to 400 KC	✓	✓	
Circuit Board Extender (Singer Model 1865)				

f. If necessary, adjust coil L1 to obtain best compromise for all switch positions.

7-18. Adjust output oscillator circuits as follows:

a. Connect oscilloscope vertical input to TP1 of module under test.

b. Connect oscilloscope horizontal input to the output of the previous module (TP3 of A1 or TP5 of A2, A3, and A4).

c. Set selector switch for the previous module to 4.

d. Set selector switch for the module under test to 0.

e. Adjust oscilloscope to check Lissajous patterns in the 30 to 39 KC range.

f. Check that a 1 to 1 Lissajous pattern as shown in figure 7-5 is indicated. If necessary, adjust coil L5 to obtain pattern.

g. Repeat test at the following switch positions:

SWITCH POSITION	COIL
0	L5
1	L6
2	L7
3	L8
4	L9
5	L10
6	L11
7	L12
8	L13
9	L14

h. Repeat check with the switch for the previous module set to 0 and 9.

i. Connect oscilloscope vertical to TP1.

j. Adjust resistor R31 for maximum undistorted output at all switch positions.

7-19. Adjust divider as follows:

a. Connect counter to TP3.

b. Connect VTVM to the emitter of Q20.

c. Set switch for previous modules to 0.

d. Set switch for module under test to 9.

e. Check that output frequency is 39 KC.

f. Vary resistor R83 until lock is lost (output frequency varies from 39 KC ±1 cps). Note maximum and minimum lock voltage and set resistor R83 to approximately the midpoint of the lock voltage range.

TABLE 7-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Emitter voltage should be within ±.5 vdc of base voltage.

c. Supply voltage of 22.0 vdc.

TRANSISTOR	BASE	COLLECTOR
Q1	0	18
Q2	9.6 - 12	18
Q3	3.2 - 6	9.5 - 13
Q4	3.8 - 6.4	11 - 14
Q5	11 - 14	21
Q6	11 - 14	21
Q7	1 - 2	16 - 17
Q8	2.2	7.4 - 8.5
Q9	9.5 - 10	21
Q10	.4 - .7	8 - 10
Q11	3.2	6 - 8
Q12	.6 - .7	4.4 - 6.2
Q13	2.9 - 3.1	13
Q14	3.6 - 3.8	10
Q15	3.2	12.5
Q16	4 - 5	7 - 10
Q17	2 - 5	7.6
Q18	2	15
Q19	3.8	12
Q20	4	11 - 13

TABLE 7-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	Pin H	VTVM	+22 ±1 vdc	
2. 10 KC Input	Pin E	Scope	Square wave 7 ±1V peak-to-peak	
3. Harmonic Oscillator Output	TP2	Counter	270 to 360 KC	Frequency set by selector switch. 0 = 270 KC, 1 = 280 KC, 2 = 290 KC, etc.

TABLE 7-3. DYNAMIC MEASUREMENTS (CONT)

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
3. Harmonic Oscillator Output (cont)		Scope	Sine wave, 6V peak-to-peak	
4. Phase Detector for Harmonic Oscillator	TP3	VTVM	-4.6 to +3.6 vdc (approximate lock range)	Varying dc voltage indicates lack of lock.
5. IF Signal	TP1	Counter	30 to 40 KC	Frequency set by previous modules. 0 = 30 KC, 1 = 31 KC, etc.
		Scope	Sine wave, 15.0 ±0.5 volts peak-to-peak	
6. Output Oscillator	TP4	Counter	300 to 400 KC	See adjustment procedure.
7. Output Signal	TP5	Counter	30 to 40 KC	See adjustment procedure.
		Scope	Rounded square wave, 6 to 8 volts peak-to-peak	

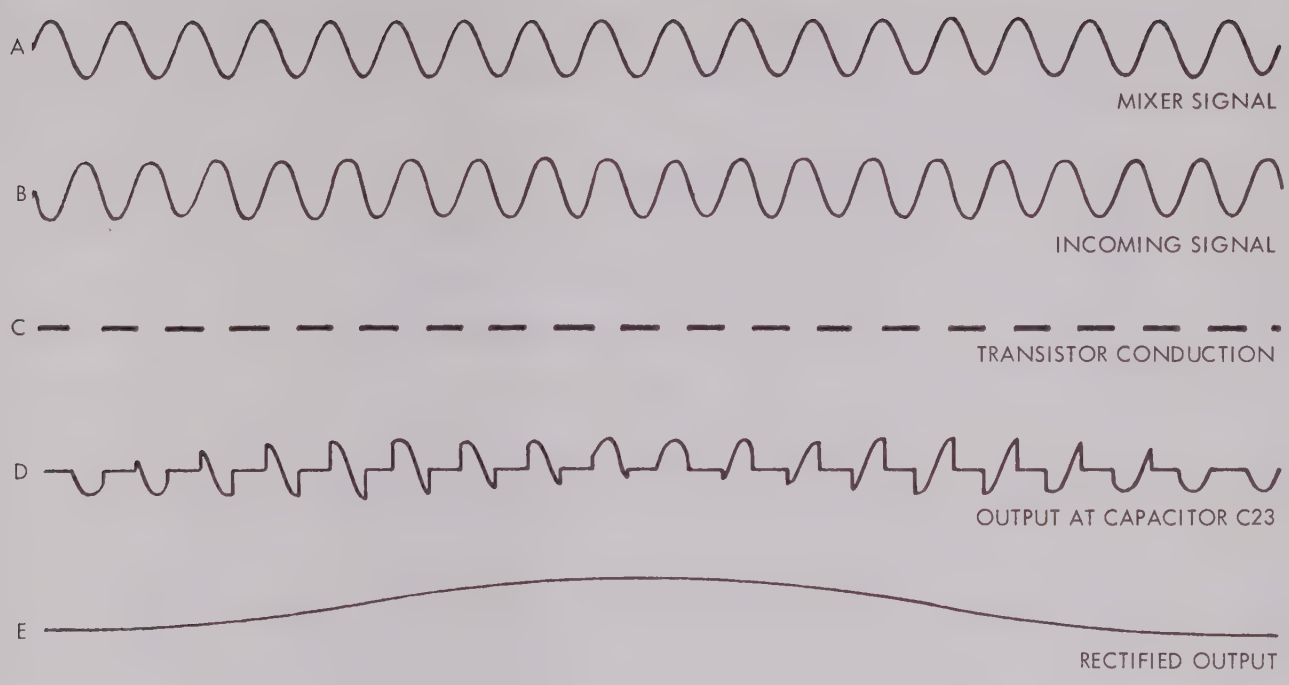


Figure 7-4. Phase Detector Operation for Difference in Frequency

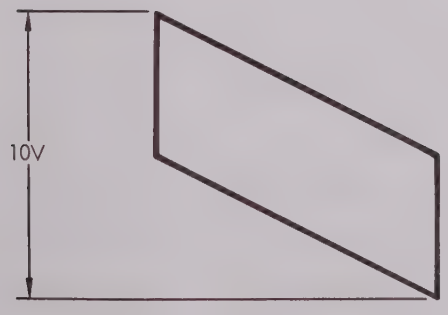


Figure 7-5. Lissajous Adjustment Pattern

REF DESIG	ITEM	MFR	PART NO.
C62	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C63	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C64	Capacitor, mylar, 0.0022 uf, 50V	Paktron	MR330-.0022
C65	Capacitor, disc, 0.001 uf	Erie	861Z5U.001
C66	Capacitor, disc, 0.001 uf	Erie	861Z5U.001
CR1	Diode	Texas Instr	1N914
CR2	Diode	Texas Instr	1N914
CR3	Diode	Texas Instr	1N914
CR4	Diode	Texas Instr	1N914
CR5	Diode	Texas Instr	1N914
CR6	Diode	Philco	V4090
CR7	Diode	Philco	V4092
CR8	Diode	Texas Instr	1N914
CR9	Diode	Texas Instr	1N914
CR10	Diode	Texas Instr	1N914
CR11	Diode	Texas Instr	1N914
CR12	Diode	Texas Instr	1N914
CR13	Diode	Texas Instr	1N914
CR14	Diode	Texas Instr	1N914
CR15	Diode	Texas Instr	1N914
CR16	Diode	Texas Instr	1N914
L1	Coil, variable	Singer	LR-25-2
L2	Coil, 10 mh	Delevan	2500-76
L3	Coil, 10 mh	Delevan	2500-76
L4	Coil, 10 mh	Delevan	2500-76
L5	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L6	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L7	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L8	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L9	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L10	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L11	Coil, variable, 625 to 950 uh	Singer	LR-26-4

REF DESIG	ITEM	MFR	PART NO.
L12	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L13	Coil, variable, 400 to 625 uh	Singer	LR-26-3
L14	Coil, variable, 400 to 625 uh	Singer	LR-26-3
L15	Coil, 150 mh	Collins	MIC-29
Q1	Transistor	GE	2N2924
Q2	Transistor	GE	2N2924
Q3	Transistor	GE	2N2924
Q4	Transistor	GE	2N2924
Q5	Transistor	GE	2N2924
Q6	Transistor	GE	2N2924
Q7	Transistor	GE	2N2924
Q8	Transistor	GE	2N2924
Q9	Transistor	GE	2N2924
Q10	Transistor	GE	2N2924
Q11	Transistor	GE	2N2924
Q12	Transistor	GE	2N2924
Q13	Transistor	GE	2N2924
Q14	Transistor	GE	2N2924
Q15	Transistor	GE	2N2924
Q16	Transistor	GE	2N2924
Q17	Transistor	GE	2N2924
Q18	Transistor	GE	2N2924
Q19	Transistor	GE	2N2924
Q20	Transistor	GE	2N2924
R1	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R3	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		
R4	Resistor, fixed, composition, 220K ±10%, 1/4W		
R5	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R6	Resistor, fixed, composition, 10K ±10%, 1/4W		
R7	Not used		
R8	Resistor, fixed, composition, 4.7K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R9	Resistor, fixed, composition, 1K ±10%, 1/4W		
R10	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		
R11	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R12	Resistor, fixed, composition, 22K ±10%, 1/4W		
R13	Resistor, fixed, composition, 15K ±10%, 1/4W		
R14	Resistor, fixed, composition, 15K ±10%, 1/4W		
R15	Resistor, fixed, composition, 22K ±10%, 1/4W		
R16	Resistor, fixed, composition, 47K ±10%, 1/4W		
R17	Resistor, fixed, composition, 15K ±10%, 1/4W		
R18	Resistor, fixed, composition, 22K ±10%, 1/4W		
R19	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R20	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R21	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R22	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R23	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R24	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R25	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R26	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R27	Resistor, fixed, composition, 15K ±10%, 1/4W		
R28	Resistor, fixed, composition, 47K ±10%, 1/4W		
R29	Resistor, fixed, composition, 5.6K ±10%, 1/4W		
R30	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R31	Resistor, variable, 1K	Mallory	MTC-4-1K
R32	Resistor, fixed, composition, 10K ±10%, 1/4W		
R33	Resistor, fixed, composition, 27K ±10%, 1/4W		
R34	Resistor, fixed, composition, 27K ±10%, 1/4W		
R35	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R36	Resistor, fixed, composition, 18K ±10%, 1/4W		
R37	Not used		
R38	Resistor, fixed, composition, 1K ±10%, 1/4W		
R39	Resistor, fixed, composition, 10K ±10%, 1/4W		
R40	Resistor, fixed, composition, 1.8K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R41	Resistor, fixed, composition, 10K ±10%, 1/4W		
R42	Resistor, fixed, composition, 100K ±10%, 1/4W		
R43	Resistor, fixed, composition, 22K ±10%, 1/4W		
R44	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R45	Resistor, fixed, composition, 8.2K ±10%, 1/4W		
R46	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R47	Resistor, fixed, composition, 1.2K ±10%, 1/4W		
R48	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R49	Resistor, fixed, composition, 1K ±10%, 1/4W		
R50	Resistor, fixed, composition, 3.9K ±10%, 1/4W		
R51	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R52	Resistor, fixed, composition, 10K ±10%, 1/4W		
R53	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R54	Resistor, fixed, composition, 39K ±10%, 1/4W		
R55	Resistor, fixed, composition, 27K ±10%, 1/4W		
R56	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R57	Resistor, fixed, composition, 39K ±10%, 1/4W		
R58	Resistor, fixed, composition, 27K ±10%, 1/4W		
R59	Resistor, fixed, composition, 10K ±10%, 1/4W		
R60	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R61	Resistor, fixed, composition, 39K ±10%, 1/4W		
R62	Resistor, fixed, composition, 27K ±10%, 1/4W		
R63	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R64	Resistor, fixed, composition, 39K ±10%, 1/4W		
R65	Resistor, fixed, composition, 27K ±10%, 1/4W		
R66	Resistor, fixed, composition, 10K ±10%, 1/4W		
R67	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R68	Resistor, fixed, composition, 39K ±10%, 1/4W		
R69	Resistor, fixed, composition, 10K ±10%, 1/4W		
R70	Resistor, fixed, composition, 27K ±10%, 1/4W		
R71	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R72	Resistor, fixed, composition, 39K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R73	Resistor, fixed, composition, 27K ±10%, 1/4W		
R74	Resistor, fixed, composition, 10K ±10%, 1/4W		
R75	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R76	Resistor, fixed, composition, 39K ±10%, 1/4W		
R77	Resistor, fixed, composition, 27K ±10%, 1/4W		
R78	Resistor, fixed, composition, 1.2K ±10%, 1/4W		
R79	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R80	Resistor, fixed, composition, 39K ±10%, 1/4W		
R81	Resistor, fixed, composition, 27K ±10%, 1/4W		
R82	Resistor, fixed, composition, 10K ±10%, 1/4W		
R83	Resistor, variable, 500 ohms Helitrim	Beckman	62P-R500
R84	Resistor, fixed, composition, 10K ±10%, 1/4W		
R85	Resistor, fixed, composition, 82 ohms ±10%, 1/2W		
R86	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R87	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R88	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R89	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R90	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R91	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R92	Resistor, fixed, composition, 68 ohms ±10%, 1/4W		
R93	Resistor, fixed, composition, 68 ohms ±10%, 1/4W		
R94	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R95	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R96	Resistor, fixed, composition, 470 ohms ±10%, 1/4W (located on back of board)		
R97	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R98	Resistor, fixed, composition, 22K ±10%, 1/4W		
S1	Switch	Singer	OM-1496-1
T1	Transformer	UTC	PIP-1
TP1	Test Point	Sealectro	SKT-5BC
TP2	Test Point	Sealectro	SKT-5BC
TP3 thru TP5	Test Point	Sealectro	SKT-5BC

SECTION VIII

10 KC MODULE
A5

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mica, 270 pf ±5%	Elmenco	DM15E271J
C2	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C3	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C4	Capacitor, mica, 820 pf ±5%	Elmenco	DM15E821J
C5	Capacitor, mica, 820 pf ±5%	Elmenco	DM15E821J
C6	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C7	Capacitor, N750, 200 pf	Sprague	2515
C8	Capacitor, mica, 270 pf ±5%	Elmenco	DM15E271J
C9	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C10	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C11	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C12	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C13	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C14	Capacitor, N1500, 470 pf	Erie	811N1500-471K
C15	Capacitor, mylar, 0.1 uf, 50V	Paktron	MR700-.1
C16	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C17	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C18	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C19	Capacitor, mica, 1000 pf ±5%	Elmenco	DM19E102J
C20	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C21	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-0.01
C22	Capacitor, mica, 1000 pf ±5%	Elmenco	DM19E102J
C23	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C24	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C25	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C26	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C27	Capacitor, mica, 27 pf ±5%	Elmenco	DM15E270J
C28	Capacitor, mica, 75 pf ±5%	Elmenco	DM15E750J
C29	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C30	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C31	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C32	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C33	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C34	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C35	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C36	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C37	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C38	Capacitor, mica, 47 pf±5%	Elmenco	DM15E470J
C39	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C40	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C41	Capacitor, electrolytic, 22 uf, 6V	Goodall	931-22-6-20
C42	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C43	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C44	Capacitor, mica, 390 pf ±5%	Elmenco	DM15E391J
C45	Capacitor, mica, 330 pf ±5%	Elmenco	DM15E331J
C46	Capacitor, mica, 250 pf ±5%	Elmenco	DM15E251J
C47	Capacitor, mica, 200 pf ±5%	Elmenco	DM15E201J
C48	Capacitor, mica, 150 pf ±5%	Elmenco	DM15E151J
C49	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C50	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C51	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C52	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C53	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C54	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C55	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C56	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C57	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C58	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C59	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C60	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C61	Capacitor, trimmer, 8 to 60 pf	Elmenco	404
C62	Capacitor, 0.0022 uf		

(continued on page 8-8)

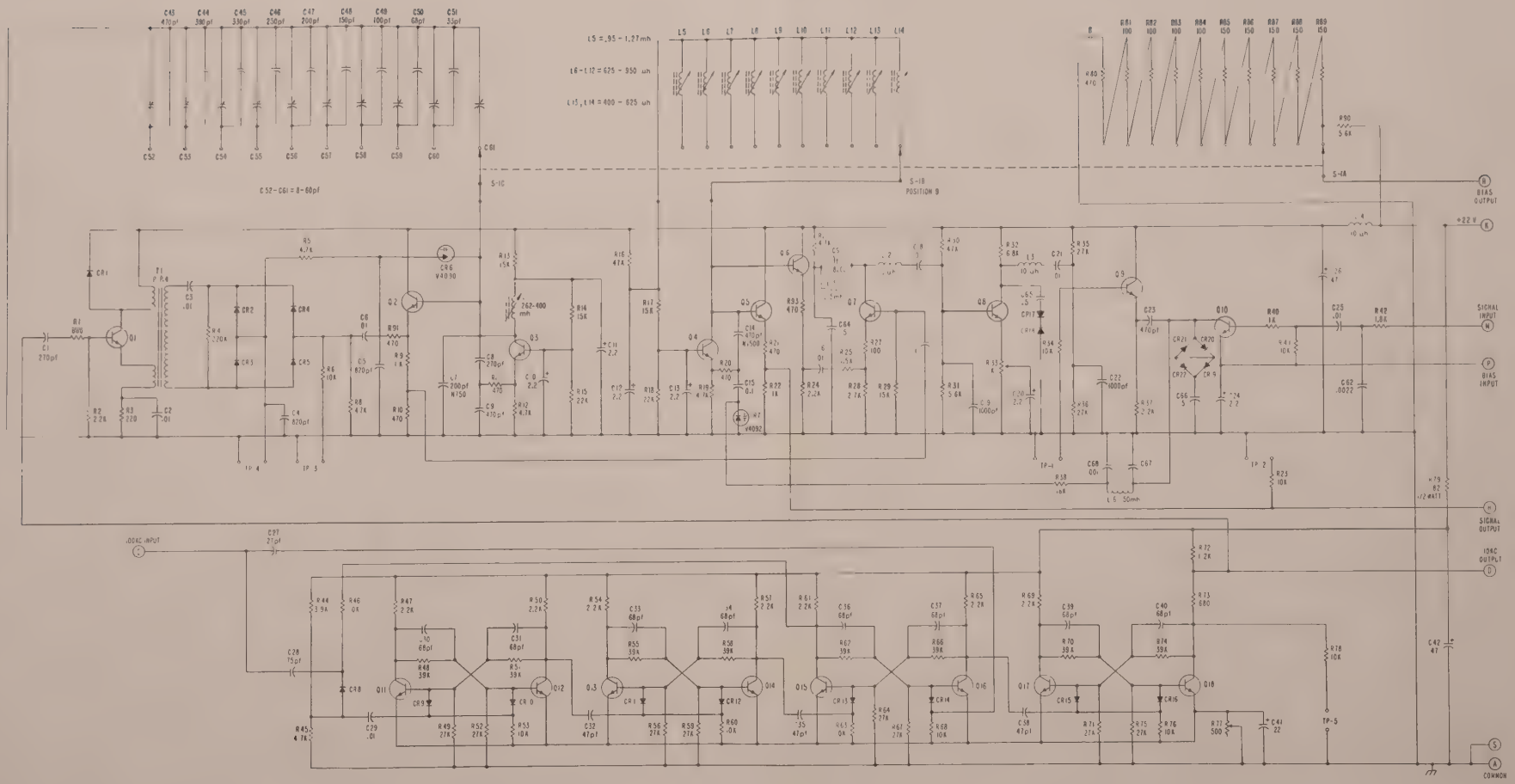


Figure 8-1. Schematic Diagram

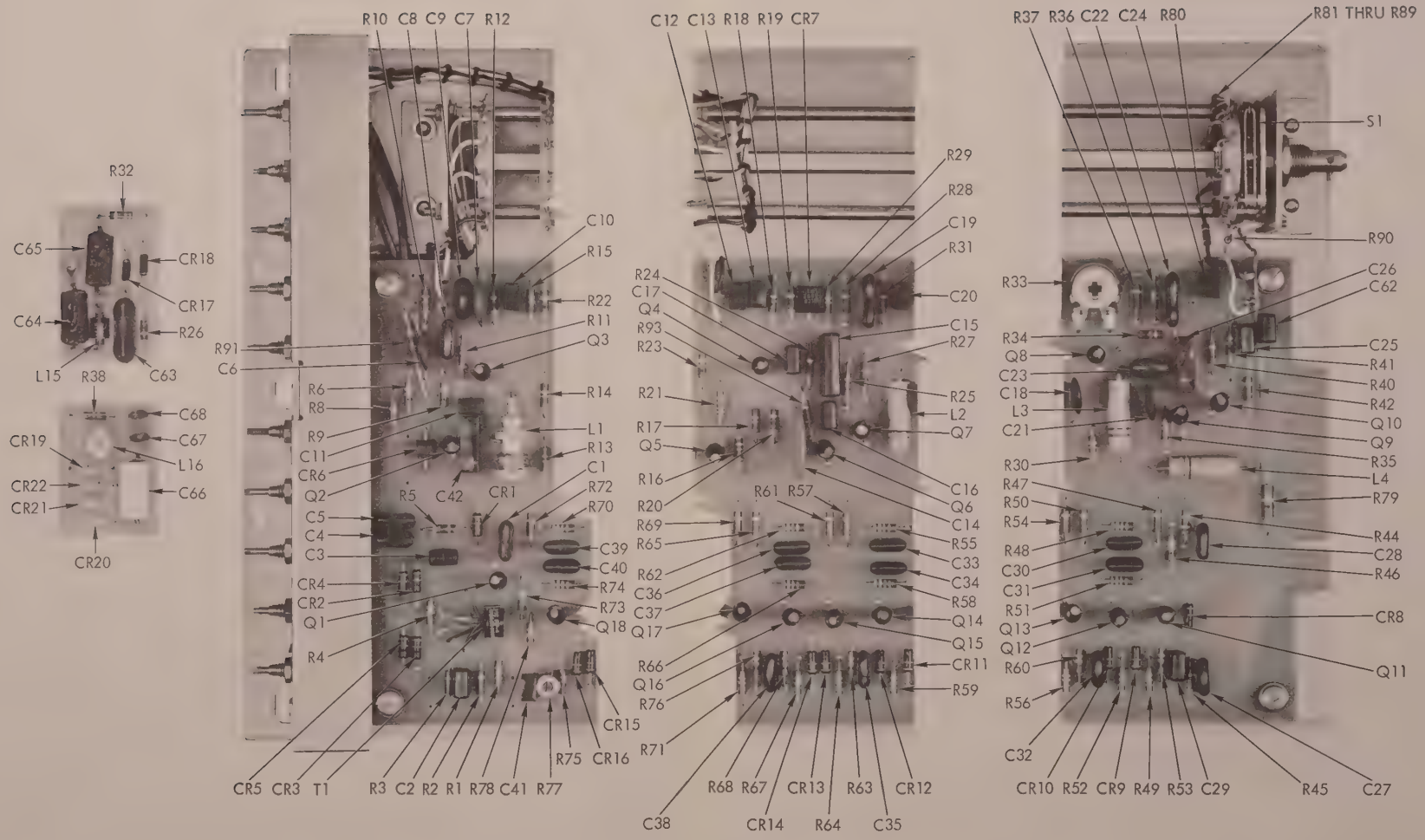


Figure 8-2. Parts Location (Sheet 1 of 2)

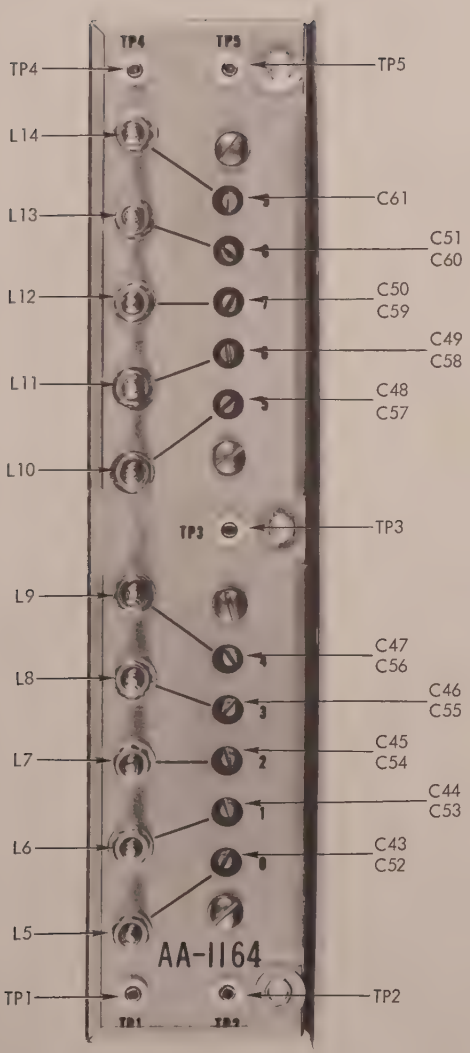


Figure 8-2. Parts Location (Sheet 2 of 2)

8-1. CIRCUIT DESCRIPTION.

8-2. The 10 KC module receives a 30 to 40 KC signal from the 1 KC module and delivers a 300 to 400 KC signal to the 100 KC module. The module also receives a 100 KC and delivers a 10 KC lock signal to the preceding modules.

8-3. The harmonic oscillator Q3, buffer Q2, and blocking oscillator Q1 operate in the same manner as for the 1 cps module (see paragraphs 6-3, 6-5, and 6-6).

8-4. The output oscillator Q4, mixer Q7, and phase detector Q10 operate in the same manner as for the 10 cps module (see paragraphs 7-4 through 7-11).

8-5. The signal from the output oscillator Q4 is applied to the succeeding module through buffer Q5. Resistors R80 through R90 provide the bias network for the succeeding stage.

8-6. The 100 KC signal from the 10 to 1 divider of the 100 KC module is applied to the 10 to 1 divider composed of transistors Q11 through Q18. The divider is a standard four-stage divider which is converted to a divide-by-ten circuit by gate pulses.

8-7. TEST EQUIPMENT.

8-8. Refer to Table 8-1 for a list of test equipment.

8-9. ADJUSTMENTS.

8-10. Adjust 10 KC divider as follows:

a. Connect counter to TP5 of 100 KC module A6. Check that a 100 KC signal is present.

b. Connect counter to TP5 of 100 KC module A5.

c. Connect VTVM to the emitter of Q18.

d. Check that output frequency is 10 KC.

e. Vary resistor R77 until lock is lost (output frequency varies from 10 KC ±1 cps). Note maximum and minimum lock voltage and set resistor R77 to approximately the midpoint of the lock voltage range.

8-11. Adjust harmonic oscillator circuits as follows:

a. Connect counter to TP3.

b. Set 10 KC selector switch to 0.

c. Check that harmonic oscillator frequency is 270 KC ±1 cps. If necessary, adjust capacitor C52 to obtain output.

d. Repeat step c for the following switch positions:

SWITCH POSITION	CAPACITOR	FREQUENCY
0	C52	270 KC
1	C53	280 KC
2	C54	290 KC
3	C55	300 KC
4	C56	310 KC
5	C57	320 KC
6	C58	330 KC
7	C59	340 KC
8	C60	350 KC
9	C61	360 KC

TABLE 8-1. TEST EQUIPMENT

ITEM	RANGE	ADJUSTMENT	TROUBLE SHOOTING	NOTES
VTVM	1 to 22 vdc	✓	✓	
Oscilloscope	30 to 40 KC 5 to 20V p-p	✓	✓	A scope with a vertical signal output and a high impedance probe is recommended.
	300 to 400 KC 1 to 20V p-p	✓	✓	
Counter	10 KC		✓	If the counter has a low impedance probe, connect to the vertical signal output of the scope or through a high impedance probe.
	100 KC		✓	
	30 to 40 KC	✓	✓	
	300 to 400 KC	✓	✓	
Circuit Board Extender (Singer Model 1865)				

e. If necessary, adjust coil L1 to obtain best compromise for all switch positions.

8-12. Adjust output oscillator circuits as follows:

a. Connect oscilloscope vertical input to TP1.

b. Connect oscilloscope horizontal input to TP5 of 1 KC module A4.

c. Set 1 KC selector switch to 4.

d. Set 10 KC selector switch to 0.

e. Adjust oscilloscope to check Lissajous patterns in the 30 to 39 KC range.

f. Check that a 1 to 1 Lissajous pattern as shown in figure 7-5 is indicated. If necessary, adjust coil L5 to obtain pattern.

g. Repeat test at the following 10 KC selector switch positions:

SWITCH POSITION	COIL	SWITCH POSITION	COIL
0	L5	5	L10
1	L6	6	L11
2	L7	7	L12
3	L8	8	L13
4	L9	9	L14

h. Repeat test with 1 KC selector switch set to 0 and 9.

i. Connect oscilloscope to TP1.

j. Adjust resistor R33 for maximum undistorted output at all switch positions.

TABLE 8-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Supply voltage of 22.0 vdc.

c. Emitter voltage should be within ±.5 vdc of base voltage.

TRANSISTOR	BASE	COLLECTOR
Q1	0	18
Q2	12	18
Q3	6	12.5
Q4	6	13.5
Q5	14	20
Q6	14	20
Q7	1	17
Q8	2.2	7
Q9	8.7	21
Q10	.4	3.2
Q11	3.5	13
Q12	4.3	11
Q13	3.6	13
Q14	4.2	11
Q15	5	8
Q16	2.8	17

TABLE 8-2. TYPICAL DC VOLTAGES (CONT)

TRANSISTOR	BASE	COLLECTOR
Q17	4	12
Q18	4	12

TABLE 8-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	Pin K, J68	VTVM	+22 ±1 vdc	
2. 100 KC Input	Pin C, J68	Scope	Square wave, 7 ±1V peak-to-peak	
3. 10 KC Output	TP5	Counter	10.000 KC	
		Scope	Square wave, 7 ±1V peak-to-peak	
4. Harmonic Oscillator Output	TP3	Counter	270 to 360 KC	Frequency set by selector switch 0 = 270 KC, 1 = 280 KC, 2 = 290 KC, etc.
		Scope	Sine wave, 6V peak-to-peak	
5. Phase Detector for Harmonic Oscillator	TP4	VTVM	-4.6 to +3.6 vdc (approximate lock range)	Varying dc voltage indicates lack of lock.
6. Output Signal	TP2	Counter	300 to 400 KC	See checkout procedure.

REF DESIG	ITEM	MFR	PART NO.
C63	Capacitor, mica, 8200 pf ±5%	Elmenco	DM19E822J
C64	Capacitor, mylar, 0.5 uf ±20%	Hopkins	P52DS
C65	Capacitor, mylar, 0.5 uf ±20%	Hopkins	P52DS
C66	Capacitor, mylar, 0.5 uf ±20%	Jedco	1143
C67	Capacitor, disc, 0.001 uf	Eric	861Z5U103K
C68	Capacitor, disc, 0.001 uf	Eric	861Z5U103K
CR1	Diode	Texas Instr	1N914
CR2	Diode	Texas Instr	1N914
CR3	Diode	Texas Instr	1N914
CR4	Diode	Texas Instr	1N914
CR5	Diode	Texas Instr	1N914
CR6	Diode, capacitive reactance	Philco	V4090
CR7	Diode, capacitive reactance	Philco	V4092
CR8	Diode	Texas Instr	1N914
CR9	Diode	Texas Instr	1N914
CR10	Diode	Texas Instr	1N914
CR11	Diode	Texas Instr	1N914
CR12	Diode	Texas Instr	1N914
CR13	Diode	Texas Instr	1N914
CR14	Diode	Texas Instr	1N914
CR15	Diode	Texas Instr	1N914
CR16	Diode	Texas Instr	1N914
CR17	Diode	Motorola	WZ1431
CR18	Diode	Motorola	WZ1431
CR19	Diode	Texas Instr	1N914
CR20	Diode	Texas Instr	1N914
CR21	Diode	Texas Instr	1N914
CR22	Diode	Texas Instr	1N914
L1	Coil, variable, 262 to 400 uh	Singer	LR-25-2
L2	Coil, 10 mh	Delevan	2500-76
L3	Coil, 10 mh	Delevan	2500-76
L4	Coil, 10 mh	Delevan	2500-76

REF DESIG	ITEM	MFR	PART NO.
L5	Coil, variable, 0.95 to 1.27 mh	Singer	LR-26-5
L6	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L7	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L8	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L9	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L10	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L11	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L12	Coil, variable, 625 to 950 uh	Singer	LR-26-4
L13	Coil, variable, 400 to 625 uh	Singer	LR-26-3
L14	Coil, variable, 400 to 625 uh	Singer	LR-26-3
L15	Coil, 2.50 mh	Miller	70F253A1
L16	Coil, 150 mh	Collins	MIC-29
Q1	Transistor	GE	2N2924
Q2	Transistor	GE	2N2924
Q3	Transistor	GE	2N2924
Q4	Transistor	GE	2N2924
Q5	Transistor	GE	2N2924
Q6	Transistor	GE	2N2924
Q7	Transistor	GE	2N2924
Q8	Transistor	GE	2N2924
Q9	Transistor	GE	2N2924
Q10	Transistor	GE	2N2924
Q11	Transistor	GE	2N2924
Q12	Transistor	GE	2N2924
Q13	Transistor	GE	2N2924
Q14	Transistor	GE	2N2924
Q15	Transistor	GE	2N2924
Q16	Transistor	GE	2N2924
Q17	Transistor	GE	2N2924
Q18	Transistor	GE	2N2924
R1	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 2.2K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R3	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		
R4	Resistor, fixed, composition, 220K ±10%, 1/4W		
R5	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R6	Resistor, fixed, composition, 10K ±10%, 1/4W		
R7	Not used		
R8	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R9	Resistor, fixed, composition, 1K ±10%, 1/4W		
R10	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R11	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R12	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R13	Resistor, fixed, composition, 15K ±10%, 1/4W		
R14	Resistor, fixed, composition, 15K ±10%, 1/4W		
R15	Resistor, fixed, composition, 22K ±10%, 1/4W		
R16	Resistor, fixed, composition, 47K ±10%, 1/4W		
R17	Resistor, fixed, composition, 15K ±10%, 1/4W		
R18	Resistor, fixed, composition, 22K ±10%, 1/4W		
R19	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R20	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R21	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R22	Resistor, fixed, composition, 1K ±10%, 1/4W		
R23	Resistor, fixed, composition, 10K ±10%, 1/4W		
R24	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R25	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R26	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R27	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R28	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R29	Resistor, fixed, composition, 15K ±10%, 1/4W		
R30	Resistor, fixed, composition, 47K ±10%, 1/4W		
R31	Resistor, fixed, composition, 5.6K ±10%, 1/4W		
R32	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R33	Resistor, variable, 1K	Mallory	MTC-4-1K
R34	Resistor, fixed, composition, 10K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R35	Resistor, fixed, composition, 27K ±10%, 1/4W		
R36	Resistor, fixed, composition, 27K ±10%, 1/4W		
R37	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R38	Resistor, fixed, composition, 18K ±10%, 1/4W		
R39	Not used		
R40	Resistor, fixed, composition, 1K ±10%, 1/4W		
R41	Resistor, fixed, composition, 10K ±10%, 1/4W		
R42	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R43	Not used		
R44	Resistor, fixed, composition, 3.9K ±10%, 1/4W		
R45	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R46	Resistor, fixed, composition, 10K ±10%, 1/4W		
R47	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R48	Resistor, fixed, composition, 39K ±10%, 1/4W		
R49	Resistor, fixed, composition, 27K ±10%, 1/4W		
R50	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R51	Resistor, fixed, composition, 39K ±10%, 1/4W		
R52	Resistor, fixed, composition, 27K ±10%, 1/4W		
R53	Resistor, fixed, composition, 10K ±10%, 1/4W		
R54	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R55	Resistor, fixed, composition, 39K ±10%, 1/4W		
R56	Resistor, fixed, composition, 27K ±10%, 1/4W		
R57	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R58	Resistor, fixed, composition, 39K ±10%, 1/4W		
R59	Resistor, fixed, composition, 27K ±10%, 1/4W		
R60	Resistor, fixed, composition, 10K ±10%, 1/4W		
R61	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R62	Resistor, fixed, composition, 39K ±10%, 1/4W		
R63	Resistor, fixed, composition, 10K ±10%, 1/4W		
R64	Resistor, fixed, composition, 27K ±10%, 1/4W		
R65	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R66	Resistor, fixed, composition, 39K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R67	Resistor, fixed, composition, 27K ±10%, 1/4W		
R68	Resistor, fixed, composition, 10K ±10%, 1/4W		
R69	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R70	Resistor, fixed, composition, 39K ±10%, 1/4W		
R71	Resistor, fixed, composition, 27K ±10%, 1/4W		
R72	Resistor, fixed, composition, 1.2K ±10%, 1/4W		
R73	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R74	Resistor, fixed, composition, 39K ±10%, 1/4W		
R75	Resistor, fixed, composition, 27K ±10%, 1/4W		
R76	Resistor, fixed, composition, 10K ±10%, 1/4W		
R77	Resistor, variable, 500 ohms	Beckman	62P-R500
R78	Resistor, fixed, composition, 10K ±10%, 1/4W		
R79	Resistor, fixed, composition, 82 ohms ±10%, 1/2W		
R80	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R81	Resistor, fixed, composition, 150 ohms ±10%, 1/4W		
R82	Resistor, fixed, composition, 150 ohms ±10%, 1/4W		
R83	Resistor, fixed, composition, 150 ohms ±10%, 1/4W		
R84	Resistor, fixed, composition, 150 ohms ±10%, 1/4W		
R85	Resistor, fixed, composition, 150 ohms ±10%, 1/4W		
R86	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R87	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R88	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R89	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R90	Resistor, fixed, composition, 5.6K ±10%, 1/4W		
R91	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R92	Not used		
R93	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
S1	Switch	Singer	OM-1496-1
T1	Transformer	UTC	PIP-4
TP1 thru TP5	Test Point	Scalectro	SKT-5BC

SECTION IX

100 KC MODULE
A6

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mica, 180 pf ±5%	Elmenco	DM15E181J
C2	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C3	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C4	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C5	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C6	Capacitor, mylar, 0.01 uf, 50V (located on back of board)	Paktron	MR330-.01
C7	Not used		
C8	Capacitor, mica, 200 pf ±5%, N1500	Erie	811N1500-201K
C9	Capacitor, mica, 82 pf ±5%	Elmenco	DM15E820J
C10	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C11	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C12	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C13	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C14	Capacitor, disc, 100 pf ±5%	Sprague	10TCN-T10
C15	Capacitor, mylar, 0.1 uf, 50V	Paktron	MR700-.1
C16	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C17	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C18	Capacitor, disc, 0.005 uf	Erie	861Z5U502K
C19	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C20	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C21	Capacitor, disc, 0.005 uf	Erie	861Z5U502K
C22	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C23	Capacitor, mica, 120 pf ±5%	Elmenco	DM15E121J
C24	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C25	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C26	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C27	Capacitor, mica, 680 pf ±5%	Elmenco	DM15E681J
C28	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C29	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C30	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C31	Capacitor, mylar, 0.01 uf, 50V	Paktron	MR330-.01
C32	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C33	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C34	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C35	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C36	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C37	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C38	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C39	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C40	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C41	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C42	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C43	Capacitor, electrolytic, 22 uf	Goodall	931-22-35-20
C44	Capacitor, electrolytic, 47 uf	Goodall	931-47-35-20
C45	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
C46	Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
C47	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C48	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C49	Capacitor, mica, 27 pf ±5%	Elmenco	DM15E270J
C50	Capacitor, mica, 39 pf ±5%	Elmenco	DM15E390J
C51	Capacitor, mica, 43 pf ±5%	Elmenco	DM15E430J
C52	Capacitor, mica, 56 pf ±5%	Elmenco	DM15E560J
C53	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
C54	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C55	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C56	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C57	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C58	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C59	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C60	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C61	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402

(continued on page 9-8)

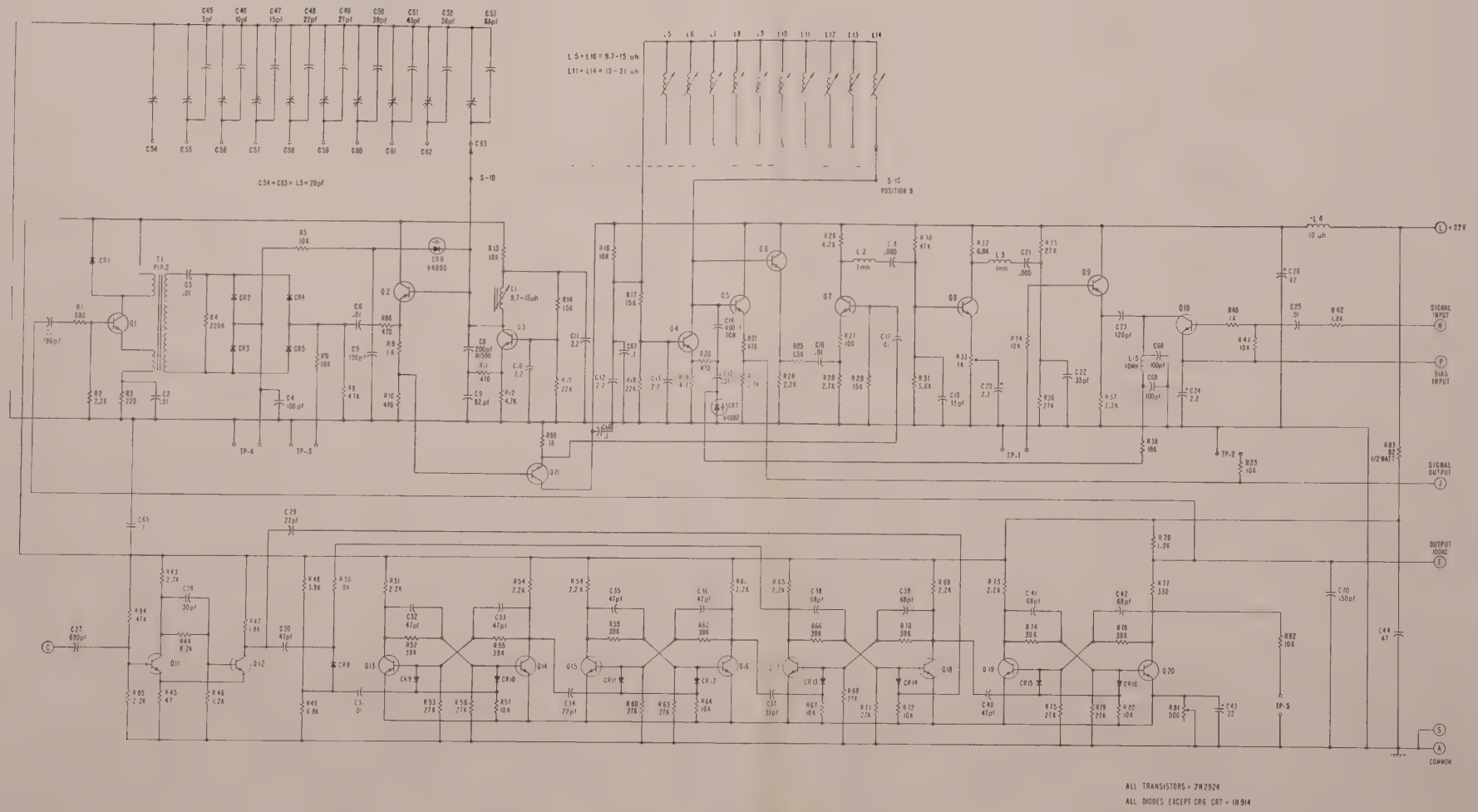


Figure 9-1. Schematic Diagram

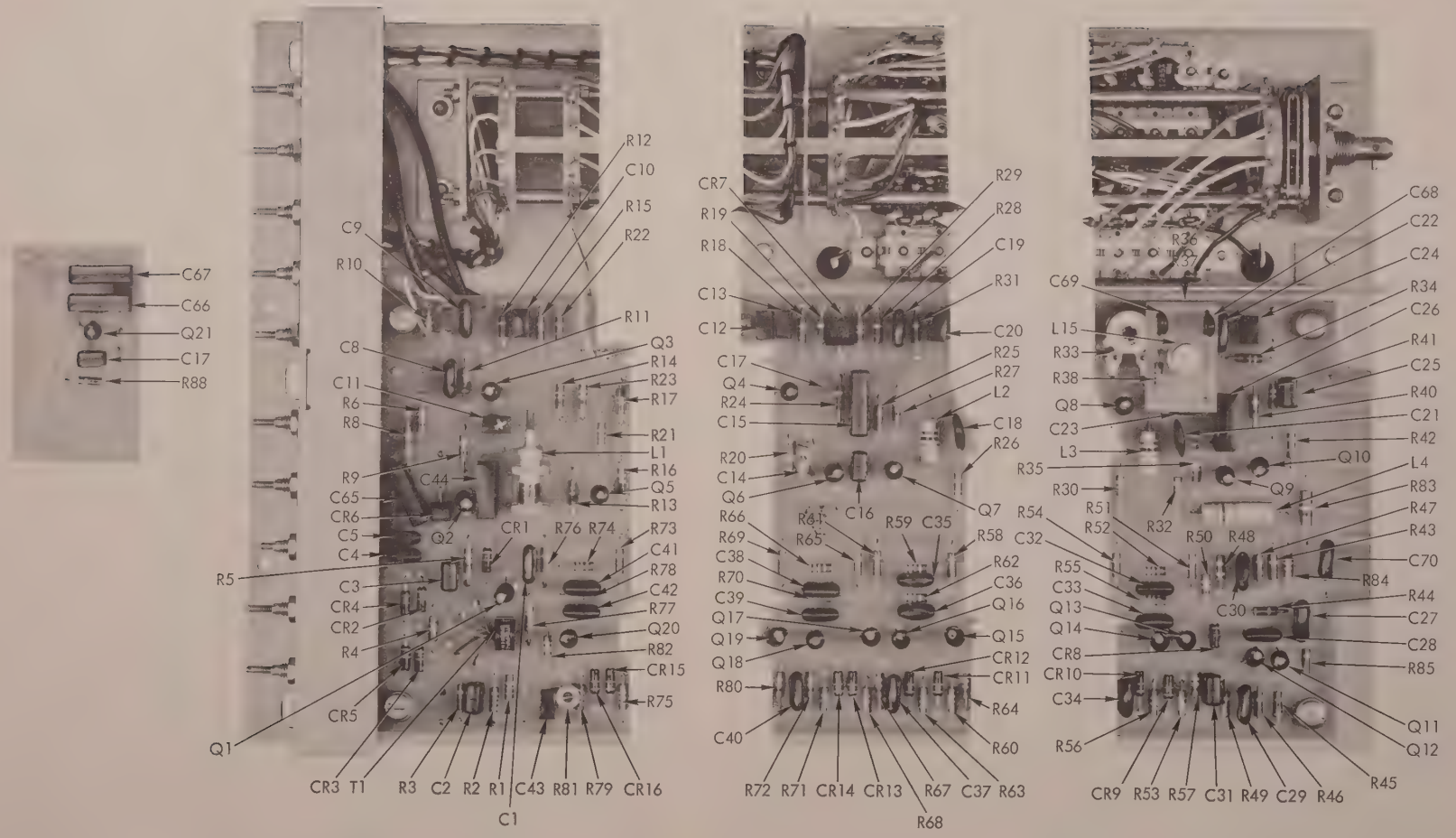


Figure 9-2. Parts Location (Sheet 1 of 2)

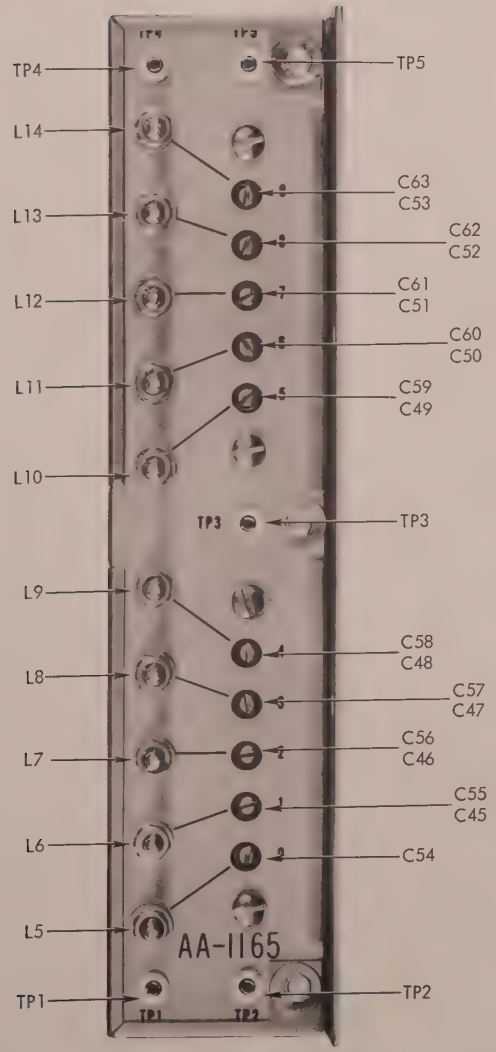


Figure 9-2. Parts Location (Sheet 2 of 2)

Figure 9-3. Lissajous Adjustment Pattern

9-1. CIRCUIT DESCRIPTION.

9-2. The 100 KC module receives a 300 to 400 KC signal from the 10 KC module and delivers a 3 to 4 MC signal to the 3 to 4 MC module A18. The module also receives a 1 MC signal from the crystal circuit and delivers a 100 KC signal to the 10 KC module.

9-3. The harmonic oscillator Q3, buffer Q2, and blocking oscillator Q1 operate in the same manner as for the 1 cps module (see paragraphs 6-3, 6-5, and 6-6). The oscillator frequency varies from 4.3 to 3.4 MC in 100 KC steps.

9-4. The output oscillator Q4, mixer Q7, and phase detector Q10 operate in the same manner as for the 10 cps module (see paragraphs 7-4 through 7-11). The output oscillator operates at the difference frequency of the harmonic oscillator and the input signal instead of the sum.

9-5. The 1 MC signal from the crystal circuit is applied through Schmitt trigger Q11 and Q12 to the 10 to 1 divider composed of transistors Q13 through Q20. The Schmitt trigger converts the input signal to the spikes required to operate the divider. The divider is a standard four-stage divider which is converted to a divide-by-ten circuit by gate pulses.

9-6. TEST EQUIPMENT.

9-7. Refer to Table 9-1 for a list of test equipment.

9-8. ADJUSTMENTS.

9-9. Adjust 100 KC divider as follows:

a. Connect counter to pin C of connector J69. Make certain that a 1 MC signal is present.

b. Connect counter to TP5.

c. Connect VTVM to the emitter of Q20.

d. Check that output frequency is 100 KC.

e. Vary resistor R81 until lock is lost (output frequency varies from 100 KC ±1 cps). Note maximum and minimum lock voltage and set resistor R81 to approximately the midpoint of the lock voltage range.

9-10. Adjust harmonic oscillator as follows:

a. Connect frequency meter to TP3.

b. Set 100 KC selector switch to 0.

c. Check that harmonic oscillator frequency is 4.3 MC ±1 cps. If necessary, adjust capacitor C54 to obtain output.

d. Repeat step c for the following switch positions:

SWITCH POSITION	CAPACITOR	FREQUENCY
0	C54	4.3 MC
1	C55	4.2 MC
2	C56	4.1 MC
3	C57	4.0 MC
4	C58	3.9 MC
5	C59	3.8 MC
6	C60	3.7 MC
7	C61	3.6 MC
8	C62	3.5 MC
9	C63	3.4 MC

TABLE 9-1. TEST EQUIPMENT

ITEM	RANGE	ADJUSTMENT	TROUBLE SHOOTING	NOTES
VTVM	1 to 22 vdc	✓	✓	
Oscilloscope	300 to 400 KC 5 to 20V p-p	✓	✓	A scope with a vertical signal output and a high impedance probe is recommended.
	3 to 4.3 MC	✓	✓	
Counter	1 MC	✓	✓	If the counter has a low impedance probe, connect to the vertical signal output of the scope or through a high impedance probe.
	100 KC	✓		
	300 to 400 KC		✓	
Frequency Meter	3 to 4.3 MC			
Circuit Board Extender (Singer Model 1865)				

e. If necessary, adjust coil L1 to obtain best compromise for all switch positions.

9-11. Adjust output oscillator circuits as follows:

a. Connect oscilloscope horizontal input to TP1.

b. Connect oscilloscope vertical input to the junction of resistor R42 and capacitor C25 (signal input from 10 KC module).

c. Set 10 KC selector switch to 4.

d. Set 100 KC selector switch to 0.

e. Adjust oscilloscope to check Lissajous patterns in the 300 to 400 KC range.

f. Check that a 1 to 1 Lissajous pattern as shown in figure 9-3 is indicated. If necessary, adjust coil L5 to obtain pattern.

g. Repeat test at the following 100 KC selector switch positions:

SWITCH POSITION	COIL	SWITCH POSITION	COIL
0	L5	5	L10
1	L6	6	L11
2	L7	7	L12
3	L8	8	L13
4	L9	9	L14

h. Repeat test with 10 KC selector switch set to 0 and 9.

i. Connect oscilloscope to TP1.

j. Adjust resistor R33 for maximum undistorted output at all switch positions.

TABLE 9-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Supply voltage of 22.0 vdc.

c. Emitter voltage should be within ±.5 vdc of base voltage.

TRANSISTOR	BASE	COLLECTOR
Q1	0	18
Q2	12	18
Q3	6.5	12
Q4	7	15
Q5	15	21
Q6	15	21
Q7	0	21
Q8	2	9
Q9	2	21
Q10	0	.8
Q11	2.5	3.6
Q12	.3	7.6
Q13	2	12
Q14	3	9.5
Q15	2.5	12
Q16	3	10

TABLE 9-2. TYPICAL DC VOLTAGES (CONT)

TRANSISTOR	BASE	COLLECTOR
Q17	4	7.2
Q18	1	15
Q19	2.7	13
Q20	3.3	9

TABLE 9-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	Pin L, J69	VTVM	+22 ±1 vdc	
2. 1 MC Input	Pin C, J69	Counter	1 MC ±1 cps	
3. 100 KC Output	TP5	Counter	100 KC ±1 cps	
		Scope	Square wave, 7 ±1V peak-to-peak	
4. Phase Detector for Harmonic Oscillator	TP4	VTVM	-4.6 to +3.6 vdc (approximate lock range)	Varying dc voltage indicates lack of lock.
5. Output Signal	TP2	Frequency Meter	4 to 3 MC	

REF DESIG	ITEM	MFR	PART NO.
C62	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C63	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C64	Not used		
C65	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C66	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C67	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C68	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C69	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C70	Capacitor, mica, 150 pf ±5%	Elmenco	DM15E151J
CR1	Diode	Texas Instr	1N914
CR2	Diode	Texas Instr	1N914
CR3	Diode	Texas Instr	1N914
CR4	Diode	Texas Instr	1N914
CR5	Diode	Texas Instr	1N914
CR6	Diode	Philco	V4090
CR7	Diode	Philco	V4090
CR8	Diode	Texas Instr	1N914
CR9	Diode	Texas Instr	1N914
CR10	Diode	Texas Instr	1N914
CR11	Diode	Texas Instr	1N914
CR12	Diode	Texas Instr	1N914
CR13	Diode	Texas Instr	1N914
CR14	Diode	Texas Instr	1N914
CR15	Diode	Texas Instr	1N914
CR16	Diode	Texas Instr	1N914
L1	Coil, variable, 9.7 to 15 uh	Singer	LR-25-1
L2	Coil, 1 mh	Delevan	2500-28
L3	Coil, 1 mh	Delevan	2500-28
L4	Coil, 10 mh	Delevan	2500-76
L5	Coil, variable, 9.7 to 15 uh	Singer	LR-26-1
L6	Coil, variable, 9.7 to 15 uh	Singer	LR-26-1
L7	Coil, variable, 9.7 to 15 uh	Singer	LR-26-1

REF DESIG	ITEM	MFR	PART NO.
L8	Coil, variable, 9.7 to 15 uh	Singer	LR-26-1
L9	Coil, variable, 9.7 to 15 uh	Singer	LR-26-1
L10	Coil, variable, 9.7 to 15 uh	Singer	LR-26-1
L11	Coil, variable, 15 to 21 uh	Singer	LR-26-2
L12	Coil, variable, 15 to 21 uh	Singer	LR-26-2
L13	Coil, variable, 15 to 21 uh	Singer	LR-26-2
L14	Coil, variable, 15 to 21 uh	Singer	LR-26-2
L15	Coil, 10 mh	Collins	MIC-14
Q1	Transistor	GE	2N2924
Q2	Transistor	GE	2N2924
Q3	Transistor	GE	2N2924
Q4	Transistor	GE	2N2924
Q5	Transistor	GE	2N2924
Q6	Transistor	GE	2N2924
Q7	Transistor	GE	2N2924
Q8	Transistor	GE	2N2924
Q9	Transistor	GE	2N2924
Q10	Transistor	GE	2N2924
Q11	Transistor	GE	2N2924
Q12	Transistor	GE	2N2924
Q13	Transistor	GE	2N2924
Q14	Transistor	GE	2N2924
Q15	Transistor	GE	2N2924
Q16	Transistor	GE	2N2924
Q17	Transistor	GE	2N2924
Q18	Transistor	GE	2N2924
Q19	Transistor	GE	2N2924
Q20	Transistor	GE	2N2924
Q21	Transistor	GE	2N2924
R1	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R3	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R4	Resistor, fixed, composition, 220K ±10%, 1/4W		
R5	Resistor, fixed, composition, 10K ±10%, 1/4W		
R6	Resistor, fixed, composition, 10K ±10%, 1/4W		
R7	Not used		
R8	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R9	Resistor, fixed, composition, 1K ±10%, 1/4W		
R10	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R11	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R12	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R13	Resistor, fixed, composition, 10K ±10%, 1/4W		
R14	Resistor, fixed, composition, 15K ±10%, 1/4W		
R15	Resistor, fixed, composition, 22K ±10%, 1/4W		
R16	Resistor, fixed, composition, 10K ±10%, 1/4W		
R17	Resistor, fixed, composition, 15K ±10%, 1/4W		
R18	Resistor, fixed, composition, 22K ±10%, 1/4W		
R19	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R20	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R21	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R22	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R23	Resistor, fixed, composition, 10K ±10%, 1/4W		
R24	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R25	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R26	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R27	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R28	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R29	Resistor, fixed, composition, 15K ±10%, 1/4W		
R30	Resistor, fixed, composition, 47K ±10%, 1/4W		
R31	Resistor, fixed, composition, 5.6 K ±10%, 1/4W		
R32	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R33	Resistor, variable, 1K	Mallory	MTC-4-1K
R34	Resistor, fixed, composition, 10K ±10%, 1/4W		
R35	Resistor, fixed, composition, 27K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R36	Resistor, fixed, composition, 27K ±10%, 1/4W		
R37	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R38	Resistor, fixed, composition, 18K ±10%, 1/4W		
R39	Not used		
R40	Resistor, fixed, composition, 1K ±10%, 1/4W		
R41	Resistor, fixed, composition, 10K ±10%, 1/4W		
R42	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R43	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R44	Resistor, fixed, composition, 8.2K ±10%, 1/4W		
R45	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R46	Resistor, fixed, composition, 1.2K ±10%, 1/4W		
R47	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R48	Resistor, fixed, composition, 3.9K ±10%, 1/4W		
R49	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R50	Resistor. fixed, composition, 10K ±10%, 1/4W		
R51	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R52	Resistor, fixed, composition, 39K ±10%, 1/4W		
R53	Resistor, fixed, composition, 27K ±10%, 1/4W		
R54	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R55	Resistor, fixed, composition, 39K ±10%, 1/4W		
R56	Resistor, fixed, composition, 27K ±10%, 1/4W		
R57	Resistor, fixed, composition, 10K ±10%, 1/4W		
R58	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R59	Resistor, fixed, composition, 39K ±10%, 1/4W		
R60	Resistor, fixed, composition, 27K ±10%, 1/4W		
R61	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R62	Resistor, fixed, composition, 39K ±10%, 1/4W		
R63	Resistor, fixed, composition, 27K ±10%, 1/4W		
R64	Resistor, fixed, composition, 10K ±10%, 1/4W		
R65	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R66	Resistor, fixed, composition, 39K ±10%, 1/4W		
R67	Resistor, fixed, composition, 10K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R68	Resistor, fixed, composition, 27K ±10%, 1/4W		
R69	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R70	Resistor, fixed, composition, 39K ±10%, 1/4W		
R71	Resistor, fixed, composition, 27K ±10%, 1/4W		
R72	Resistor, fixed, composition, 10K ±10%, 1/4W		
R73	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R74	Resistor, fixed, composition, 39K ±10%, 1/4W		
R75	Resistor, fixed, composition, 27K ±10%, 1/4W		
R76	Resistor, fixed, composition, 1.2K ±10%, 1/4W		
R77	Resistor, fixed, composition, 330 ohms ±10%, 1/4W		
R78	Resistor, fixed, composition, 39K ±10%, 1/4W		
R79	Resistor, fixed, composition, 27K ±10%, 1/4W		
R80	Resistor, fixed, composition, 10K ±10%, 1/4W		
R81	Resistor, variable, 500 ohms	Beckman	62P-R500
R82	Resistor, fixed, composition, 10K ±10%, 1/4W		
R83	Resistor, fixed, composition, 83 ohms, 1/2W		
R84	Resistor, fixed, composition, 47K ±10%, 1/4W		
R85	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R86	Resistor, fixed, composition, 470 ohms ±10%, 1/4W (located on back of board)		
R87	Not used		
R88	Resistor, fixed, composition, 1K ±10%, 1/4W		
S1	Switch	Singer	OM-1496
T1	Transformer	UTC	PIP-2
TP1	Test Point	Sealectro	SKT-5BC
TP2	Test Point	Sealectro	SKT-5BC
TP3	Test Point	Sealectro	SKT-5BC
TP4	Test Point	Sealectro	SKT-5BC
TP5	Test Point	Sealectro	SKT-5BC

SECTION X

3 TO 4 MC MODULE
A18

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, electrolytic, 15 uf, 25V	Goodall	931-15-25-20
C2	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C3	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C4	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C5	Capacitor, electrolytic, 15 uf, 25V	Goodall	931-15-25-20
C6	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C7	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C8	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C9	Not used		
C10	Capacitor, electrolytic, 15 uf, 25V	Goodall	931-15-25-20
C11	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C12	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C13	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C14	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C15	Not used		
C16	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C17	Capacitor, mica, 200 pf ±5%	Elmenco	DM15E201J
C18	Capacitor, mica, 330 pf ±5%	Elmenco	DM15E331J
C19	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C20	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C21	Capacitor, mica, 56 pf ±5%	Elmenco	DM15E560J
C22	Capacitor, mylar, 0.25 uf, 200V	Hopkins	P252D
C23	Capacitor, mica, 56 pf ±5%	Elmenco	DM15E560J
C24	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C25	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C26	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C27	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C28	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C29	Capacitor, electrolytic, 15 uf, 25V	Goodall	931-15-25-20
C30	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C31	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C32	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-20
C33	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
C34	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
C63	Capacitor, mica, 43 pf ±5%	Elmenco	DM15E430J
C64	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C65	Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
C66	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C67	Capacitor, mica, 12 pf ±5%	Elmenco	DM15E120J
C68	Capacitor, mica, 43 pf ±5%	Elmenco	DM15E430J
C69	Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
C70	Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
C71	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C72	Capacitor, mica, 12 pf ±5%	Elmenco	DM15E120J
C73	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C74	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C75	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C76	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C77	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C78	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C79	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C80	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C81	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C82	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C83	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C84	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C85	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C86	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C87	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C88	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C89	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C90	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402

(continued on page 10-8)

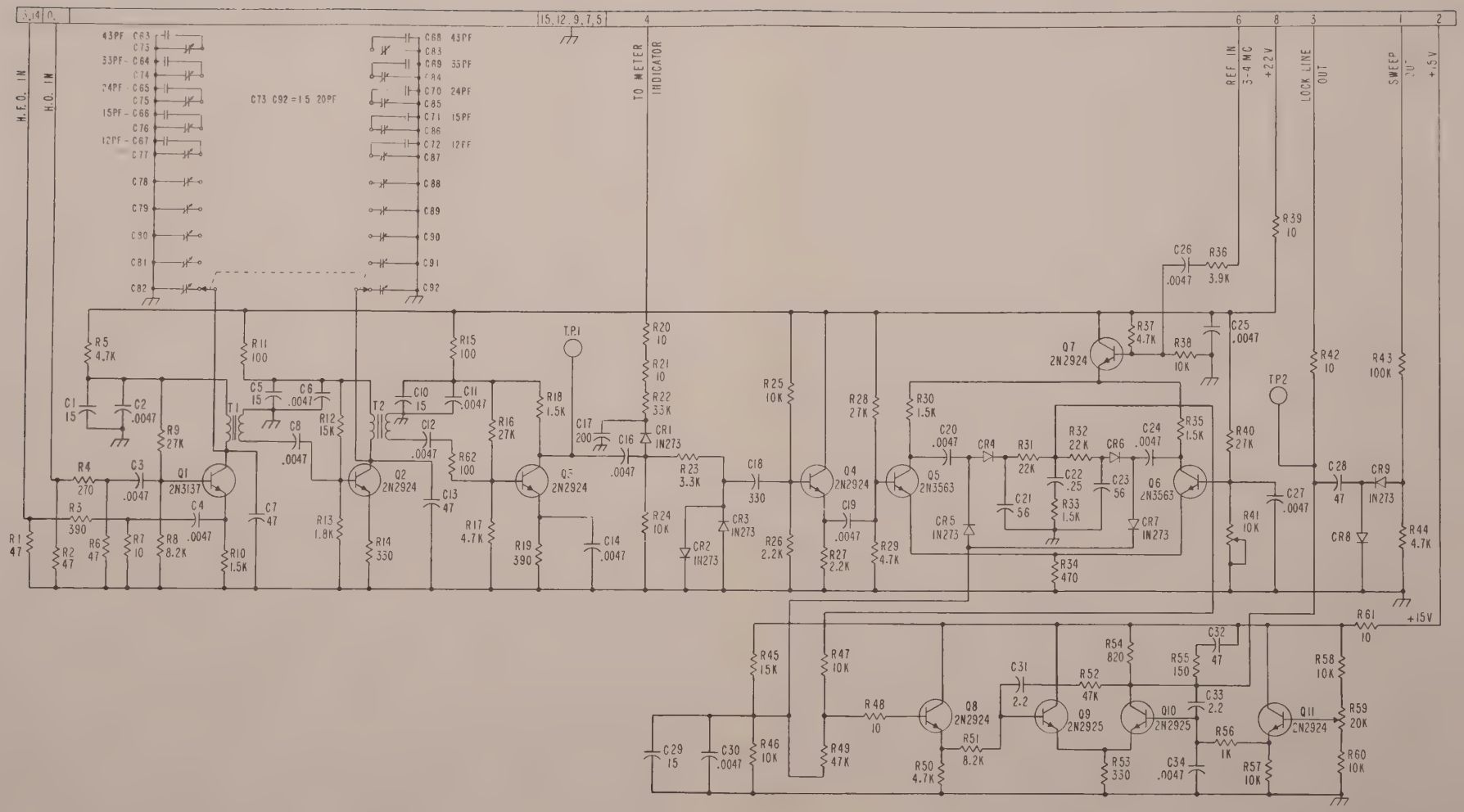


Figure 10-1. Schematic Diagram

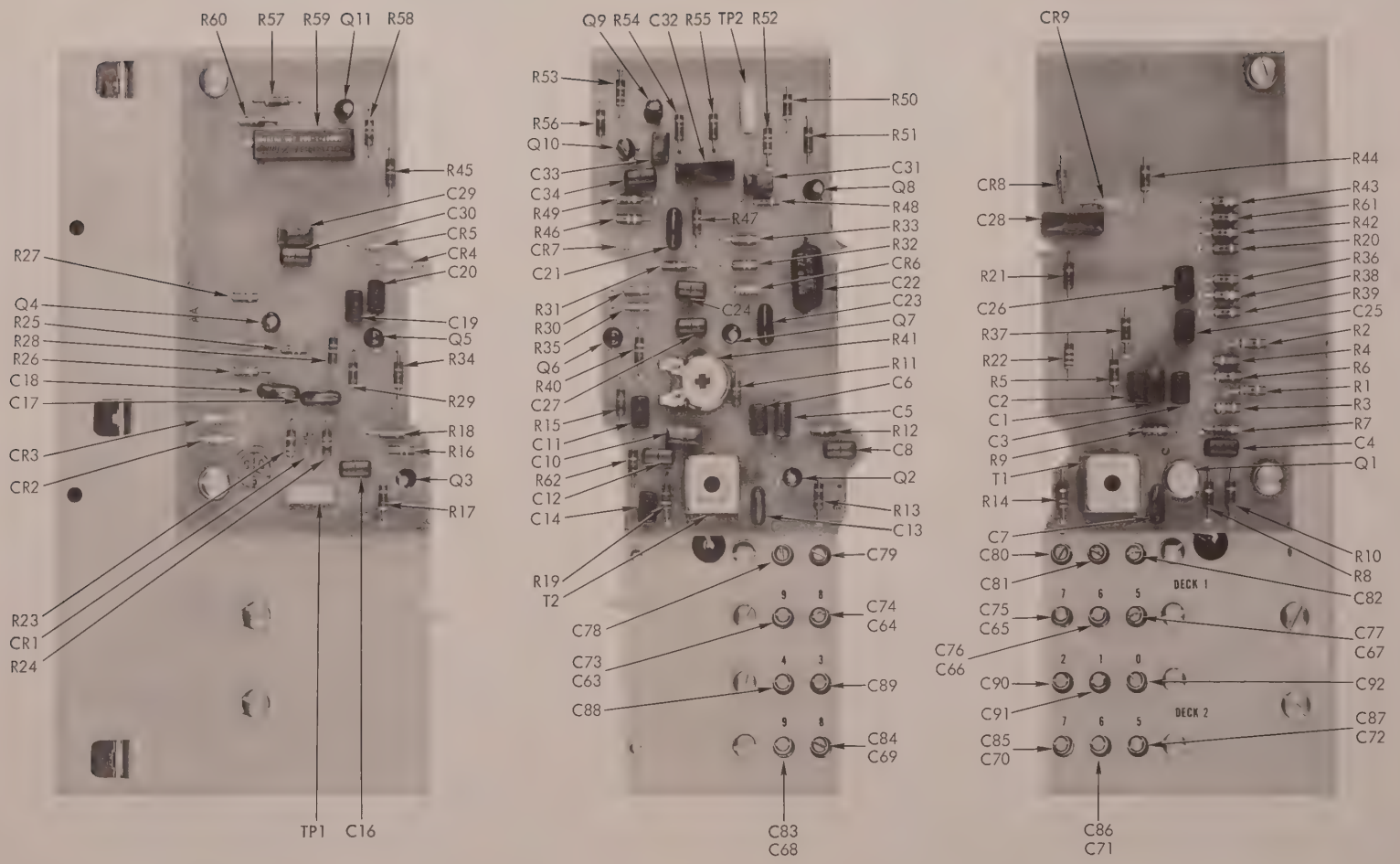


Figure 10-2. Parts Location

10-1. CIRCUIT DESCRIPTION.

10-2. The 3 to 4 MC module receives signals from the high frequency oscillator and the harmonic oscillator. These two signals are mixed to produce a 3 to 4 MC difference signal which is compared to a 3 to 4 MC signal from the synthesizer in a phase detector. The phase detector produces the dc tuning voltage for the high frequency oscillator. The circuit also produces the control signals for the Nixie control circuit (see Section XXII).

10-3. The high frequency oscillator and harmonic oscillator signals are combined in mixer Q1. The input circuits to the mixer include impedance balancing networks. The output circuit is tuned by transformer T1 and the capacitors selected by the 100 KC selector switch. This signal is amplified by amplifiers Q2 and Q3. Amplifier Q2 is tuned by the same method as the mixer. This amplified signal is applied to the TUNE-TO-MAX meter circuit through diode CR1 and to the phase detector through buffer Q4.

10-4. The signal to the meter is rectified by diode CR1 and filtered by capacitor C17. The mixer and amplifier are tuned to provide a maximum output when the high frequency oscillator and the harmonic oscillator are set to the proper frequency.

10-5. The signal to the phase detector is shaped by the diode clamp consisting of diodes CR2 and CR3. The clamping action supplies a square wave input which is applied to the base of Q5 through buffer Q4. As a result of the common emitter for Q5 and Q6, the signal developed by Q6 is 180° out-of-phase. During one half cycle diodes CR4 and CR6 will conduct and during the alternate half cycle, the diodes are cut off. Resistors R31, R32, and R33 and capacitors C21, C22, and C23 provide dc filtering. This circuit is referenced to a dc level by diodes CR5 and CR7.

10-6. The 3 to 4 MC signal from the synthesizer is applied to the phase detector through buffer Q7. The dc output from the phase detector is determined by the phase relationship of the two input signals (see figure 10-3). As long as the phase relations remain stationary, the dc output will remain stationary. If the high frequency oscillator drifts in frequency, the mixer signal drifts and the phase relations change. The dc output level from the phase detector changes and results in a retuning of the HFO.

10-7. The dc output is applied to the HFO through the dc amplifier consisting of Q8 through Q11. When the two inputs to the phase detector differ in frequency, the output is a sine wave. Under these conditions, the signal to the dc amplifier is changing rapidly and capacitor C31 provides positive feedback from Q10 to Q9. The two stages operate as a multivibrator and produce a sawtooth dc output which tunes the HFO over a broad frequency range. When the lock voltage is located, the amplifier ceases to oscillate and returns to a simple dc amplification mode.

10-8. Diodes CR8 and CR9 provide a dc sweep voltage for the Nixie control circuit.

10-9. TEST EQUIPMENT.

10-10. Refer to Table 10-1 for a list of test equipment.

10-11. ADJUSTMENTS.

10-12. To adjust the mixer circuits, proceed as follows:

a. Operate the Model SSG-1 in the SET UP mode with a frequency of 25.9 MC.

b. Connect oscilloscope TP1.

c. Carefully tune FREQUENCY control for a maximum indication on the oscilloscope.

d. Check that the oscilloscope indicates a signal level between 9 and 13 volts peak-to-peak.

e. If necessary, adjust capacitors C73 and C83 to obtain required output level.

f. Repeat test procedure at the following frequencies:

FREQUENCY	CAPACITORS	
25.9 MC	C73	C83
25.8 MC	C74	C84
25.7 MC	C75	C85
25.6 MC	C76	C86
25.5 MC	C77	C87
25.4 MC	C78	C88
25.3 MC	C79	C89
25.2 MC	C80	C90
25.1 MC	C81	C91
25.0 MC	C82	C92

g. If necessary, readjust coils L1 and L2 to obtain outputs and repeat test procedure.

10-13. To adjust the phase detector, proceed as follows:

a. Operate the Model SSG-1 in the SET UP mode with a maximum indication on the TUNE-TO-MAX meter.

b. Connect oscilloscope to the base of Q5.

c. Check that signal level is approximately .75V peak-to-peak and note signal level.

d. Connect oscilloscope to the collector of Q5.

e. Check that the gain through the stage is approximately 4 (3.3 to 3.6V peak-to-peak). If necessary, readjust resistor R41 to obtain gain.

f. Connect oscilloscope to the collector of Q6.

g. Check that the outputs of Q5 and Q6 are approximately equal (±.1 volt).

10-14. To adjust the dc amplifier, proceed as follows:

a. Operate equipment as outlined in paragraph 10-13.

b. Connect VTVM to TP2.

c. With the HFO free running, the sweep voltage should vary from 5 ±1 vdc to 14 ±1 vdc at a 3 to 5 cps rate. If necessary, adjust resistor R59 to obtain required output.

d. Operate equipment in the LOCK mode and check that a steady dc voltage in the 5 to 14 vdc range can be obtained.

TABLE 10-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	3 to 4 MC range, high impedance input or probe required.	
VTVM	0 to 22 vdc	
Circuit Board Extender (Singer Model 1865)		

TABLE 10-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Supply voltages of +22 ±.1 vdc and 15 ±.1 vdc.

b. Measured with VTVM.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	2.7	2.2	-
Q2	2	1.5	-
Q3	2.8	2.2	-
Q4	3.8	3.2	-
Q5	2.9	2.4	-
Q6	3.2	2.4	-
Q7	14	-	22
Q8	5.3	4.8	-
Q9	4.9	4.2	-
Q10	4.9	4.2	-
Q11	5.4	4.9	-

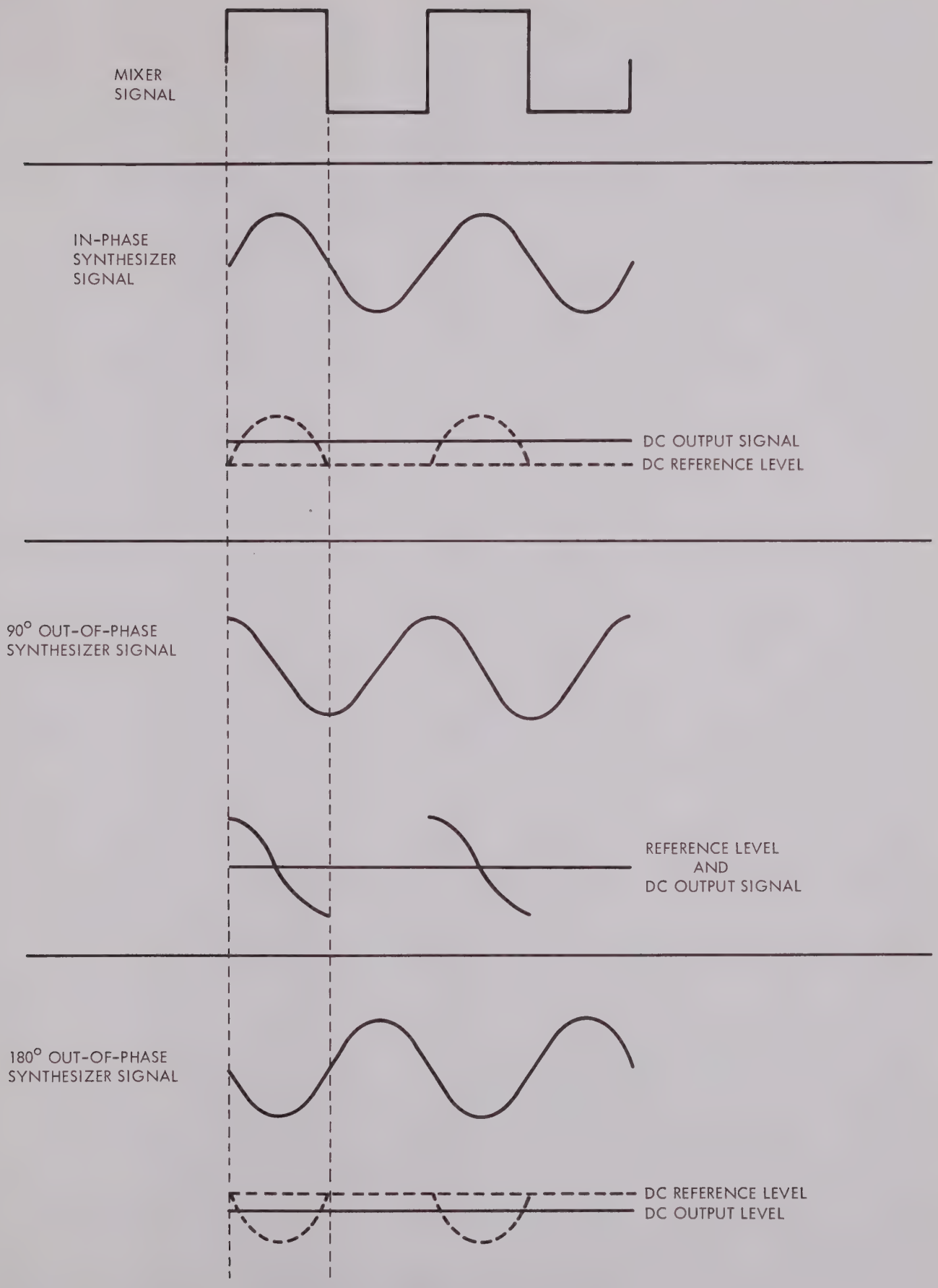


Figure 10-3. Phase Detector Waveforms

REF DESIG	ITEM	MFR	PART NO.
C91	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C92	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
CR1	Diode		1N273
CR2	Diode		1N273
CR3	Diode		1N273
CR4	Diode		1N273
CR5	Diode		1N273
CR6	Diode		1N273
CR7	Diode		1N273
CR8	Diode		1N273
CR9	Diode		1N273
Q1	Transistor		2N3137
Q2	Transistor		2N2924
Q3	Transistor		2N2924
Q4	Transistor		2N2924
Q5	Transistor		2N3563
Q6	Transistor		2N3563
Q7	Transistor		2N2924
Q8	Transistor		2N2924
Q9	Transistor		2N2925
Q10	Transistor		2N2925
Q11	Transistor		2N2924
R1	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R3	Resistor, fixed, composition, 390 ohms ±10%, 1/4W		
R4	Resistor, fixed, composition, 270 ohms ±10%, 1/4W		
R5	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R6	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R7	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R8	Resistor, fixed, composition, 8.2K ±10%, 1/4W		
R9	Resistor, fixed, composition, 27K ±10%, 1/4W		
R10	Resistor, fixed, composition, 1.5K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R11	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R12	Resistor, fixed, composition, 15K ±10%, 1/4W		
R13	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R14	Resistor, fixed, composition, 330 ohms ±10%, 1/4W		
R15	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R16	Resistor, fixed, composition, 27K ±10%, 1/4W		
R17	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R18	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R19	Resistor, fixed, composition, 390 ohms ±10%, 1/4W		
R20	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R21	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R22	Resistor, fixed, composition, 33K ±10%, 1/4W		
R23	Resistor, fixed, composition, 3.3K ±10%, 1/4W		
R24	Resistor, fixed, composition, 10K ±10%, 1/4W		
R25	Resistor, fixed, composition, 10K ±10%, 1/4W		
R26	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R27	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R28	Resistor, fixed, composition, 27K ±10%, 1/4W		
R29	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R30	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R31	Resistor, fixed, composition, 22K ±10%, 1/4W		
R32	Resistor, fixed, composition, 22K ±10%, 1/4W		
R33	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R34	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R35	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R36	Resistor, fixed, composition, 3.9K ±10%, 1/4W		
R37	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R38	Resistor, fixed, composition, 10K ±10%, 1/4W		
R39	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R40	Resistor, fixed, composition, 27K ±10%, 1/4W		
R41	Resistor, variable, 10K	Mallory	MTC-4-10K
R42	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R43	Resistor, fixed, composition, 100K ±10%, 1/4W		
R44	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R45	Resistor, fixed, composition, 15K ±10%, 1/4W		
R46	Resistor, fixed, composition, 10K ±10%, 1/4W		
R47	Resistor, fixed, composition, 10K ±10%, 1/4W		
R48	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R49	Resistor, fixed, composition, 47K ±10%, 1/4W		
R50	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R51	Resistor, fixed, composition, 8.2K ±10%, 1/4W		
R52	Resistor, fixed, composition, 47K ±10%, 1/4W		
R53	Resistor, fixed, composition, 330 ohms ±10%, 1/4W		
R54	Resistor, fixed, composition, 820 ohms ±10%, 1/4W		
R55	Resistor, fixed, composition, 150 ohms ±10%, 1/4W		
R56	Resistor, fixed, composition, 1K ±10%, 1/4W		
R57	Resistor, fixed, composition, 10K ±10%, 1/4W		
R58	Resistor, fixed, composition, 10K ±10%, 1/4W		
R59	Resistor, variable, 20K	Bourns	3068P-1-203
R60	Resistor, fixed, composition, 10K ±10%, 1/4W		
R61	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R62	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
T1	Transformer	Singer	LR-22
T2	Transformer	Singer	LR-22
TP1	Test Point	Ucinite	119437-H
TP2	Test Point	Ucinite	119437-H

SECTION XI

MC MODULE
A7

REF DESIG	ITEM	MFR	PART NO
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mylar, 0.0047 uf,	Paktron	MR330-.0047
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mica, 56 pf ±5%	Elmenco	DM15E560J
	Capacitor, mica, 33 pf ±5%		
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, electrolytic, 15 uf,	Goodall	931-15-25-20
	Capacitor, mylar, 0.0047 uf, 50V		
	Capacitor, mylar, 0.0047 uf, 50V		
	Capacitor, mylar, 0.0047 uf, 50V		
	Capacitor, mica, 120 pf ±5%		
	Capacitor, mylar, 0.0047 uf, 50V		
	Capacitor, electrolytic, 2.2 uf, 35V	Goodall	931-2.2-35-20
	Capacitor, electrolytic, 47 uf, 25V	Goodall	931-47-25-[illegible]
C17	Capacitor, electrolytic, 2.2 uf, 35V		
C18	Capacitor, mica, 15 pf ±5%		
	Capacitor, mica, 50 pf ±5%	Elmenco	DM15E500J
C22			
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mica, 22 pf ±5%		
	Capacitor, mica, 22 pf ±5%		
	Capacitor, mica, 50 pf ±5%		
	Capacitor, mica, 620 pf ±5%		
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mica, 27 pf ±5%	Elmenco	

REF DESIG	ITEM	MFR	PART NO.
C31	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
	Capacitor, mica, 120 pf ±5%	Elmenco	DM15E121J
	Capacitor, mica, 620 pf ±5%	Elmenco	DM15E621J
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
		Elmenco	DM15E680J
	Capacitor, mica, 27 pf ±5%	Elmenco	DM15E270J
	Capacitor, mica, 360 pf ±5%	Elmenco	DM15E361J
	Capacitor, mica, 620 pf ±5%	Elmenco	DM15E621J
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mylar, 0.0047 uf, 50V	Paktron	MR330-.0047
	Capacitor, mica, 82 pf ±5%	Elmenco	DM15E820J
	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
	Capacitor, mica, 360 pf ±5%	Elmenco	DM15E361J
	Capacitor, mica, 620 pf ±5%	Elmenco	DM15E621J
	Capacitor, mica, 39 pf ±5%	Elmenco	DM15E390J
	Capacitor, mica, 27 pf ±5%	Elmenco	DM15E270J
	Capacitor, mica, 110 pf ±5%	Elmenco	DM15E111J
	Capacitor, mica, 82 pf ±5%	Elmenco	DM15E820J
C50	Capacitor, mica, 68 pf ±5%	Elmenco	DM15E680J
	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
	Capacitor, mica, 39 pf ±5%	Elmenco	DM15E390J
	Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
	Capacitor, mica, 75 pf ±5%		
C55	Capacitor, mica, 47 pf ±5%	Elmenco	DM15E470J
C56	Capacitor, mica, 24 pf ±5%		DM
	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	
			402

(continued on page 11-8)

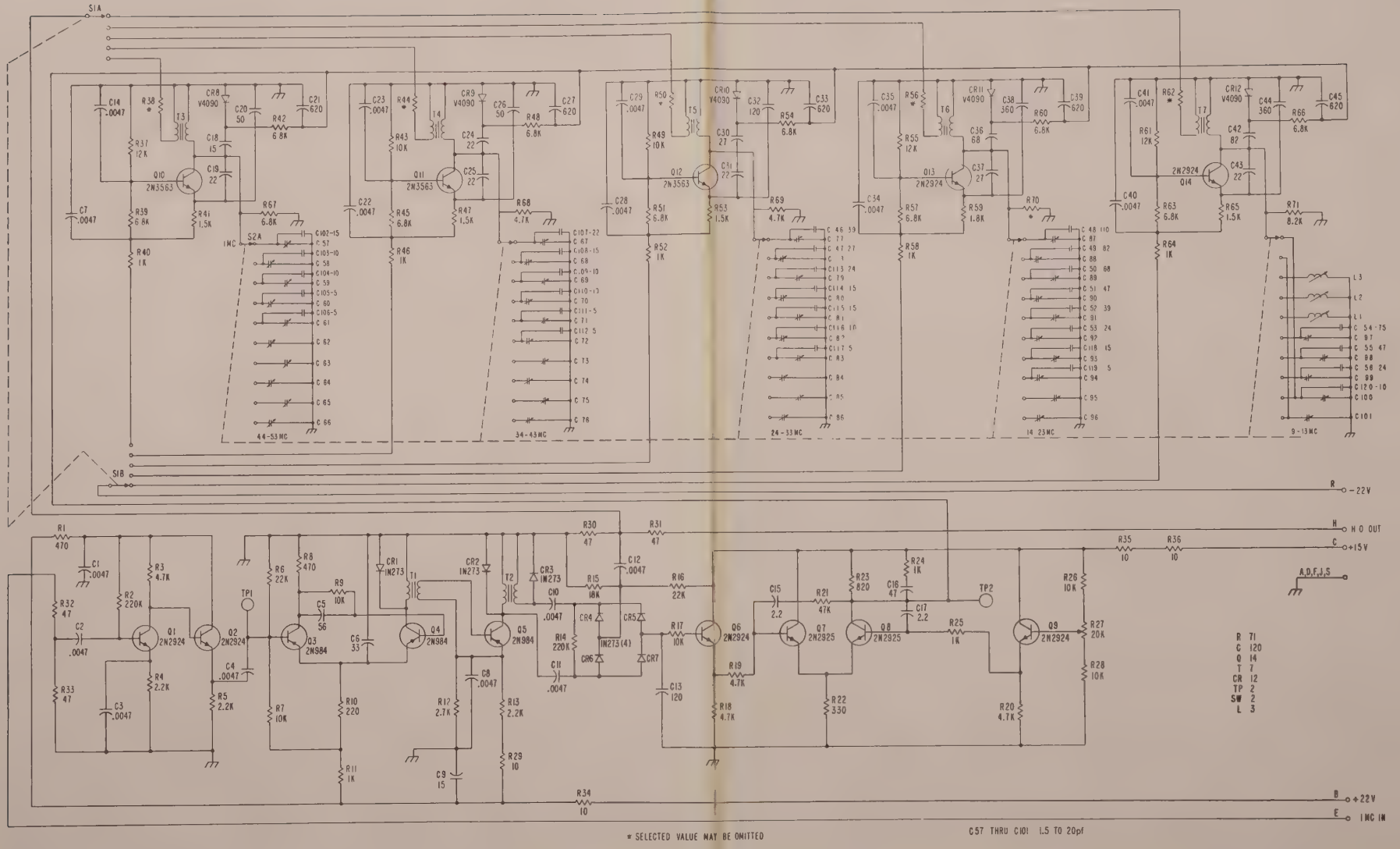


Figure 11-1. Schematic Diagram

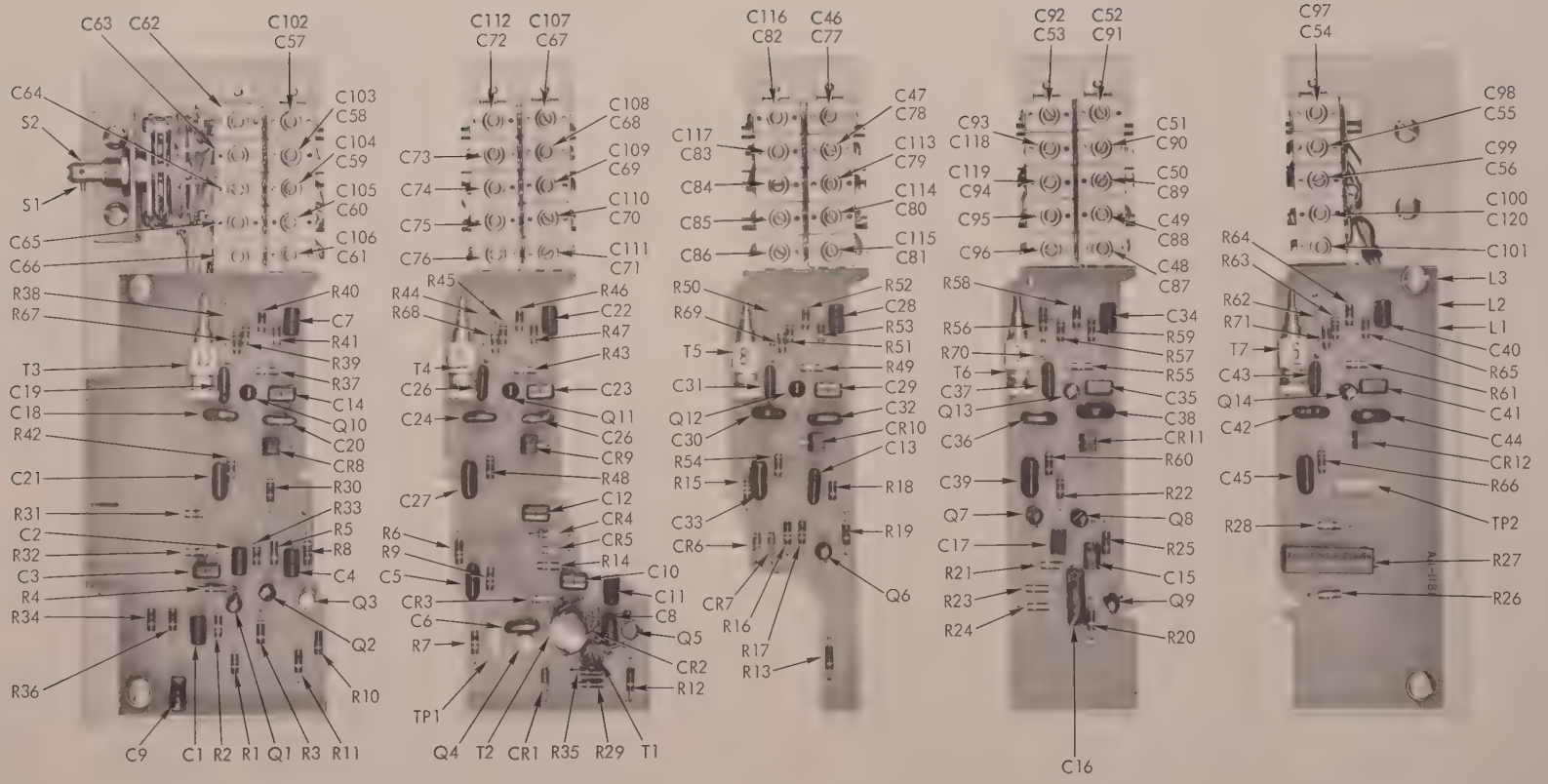


Figure 11-2. Parts Location

11-1. CIRCUIT DESCRIPTION.

11-2. The MC module functions as the harmonic oscillator for the system. The module receives a 1 MC signal from the crystal circuit and produces a signal which is 3 to 4 MC above the frequency of the high frequency oscillator. In the 0 to 5 MC range, this signal is 11 to 12 MC above the output frequency.

11-3. The module is set to frequency by a three step process. In the first step, the 10 MC selector switch S1 selects one of five oscillator circuits for a 10 MC range. In the second step, the selected oscillator is set to a 1 MC increment by the 1 MC selector switch S2. In this step, the oscillator is rough tuned by selection of a tank circuit capacitor. In the final step, the oscillator is tuned to an exact harmonic of 1 MC by a phase lock loop. A capacitive reactance diode in the tank circuit is controlled by the dc voltage output of phase detector CR4 through CR7.

11-4. Each of the five oscillators is a grounded-base, tuned-collector type. The capacitive reactance diode is located in the collector tank circuit.

11-5. Shaper amplifier Q1 and Q2 and Schmitt trigger Q3 and Q4 convert the 1 MC input signal to a gate pulse with a very narrow pulse width (effectively .01μ second). The shaper amplifier is over driven and produces approximately a square wave output. The Schmitt trigger produces spikes which are applied to the phase detector through buffer Q5.

11-6. The dc output of the phase detector is determined by the phase relations between the gate pulse and the oscillator signal (see figure 6-3 and paragraph 6-6).

11-7. The dc output is applied to the reactance diode through amplifier Q6 and dc amplifier Q7 through Q9. The dc amplifier assists in locating a lock voltage and is similar to the dc amplifier of the 3 to 4 MC module A18 (see paragraph 10-7).

11-8. TEST EQUIPMENT.

11-9. Refer to Table 11-1 for a list of test equipment.

11-10. ADJUSTMENTS.

11-11. To adjust the dc amplifier, proceed as follows:

a. Connect oscilloscope or counter to pin E of J71. Make certain that a 1 MC signal is present.

b. Connect oscilloscope to TP1. Make certain that the output of the shaper amplifier is approximately a square wave with an amplitude of 8V peak-to-peak.

c. Connect frequency meter to pin H of J71.

d. Connect VTVM to TP2.

e. Set the Model SSG-1 to a frequency of 11 MC in the SET UP mode.

f. Adjust capacitor C88 until lock is lost (voltage at TP2 varies rapidly and the harmonic oscillator frequency varies from 15 MC).

g. Check that voltage at TP2 varies from 4.5 ±.5 vdc and 15 ±.5 vdc at a 1/2 to 5 cps rate. If necessary, adjust resistor R27 to obtain voltage variation.

h. Readjust capacitor C88 until the oscillator is locked (voltage at TP2 is steady and the harmonic oscillator frequency is 15 MC ±1.5 cps.

11-12. To adjust the harmonic oscillators, proceed as follows:

a. Connect frequency meter to pin H of J71.

b. Connect VTVM to TP2.

c. Operate the Model SSG-1 in the SET UP mode.

d. Set the decade controls to 0 MC.

e. Check that the harmonic oscillator is locked to a frequency of 1 MC. If necessary, adjust capacitor C100 to obtain output frequency.

f. Repeat check at all frequencies listed in Table 11-2.

TABLE 11-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Frequency Meter (Singer Model FM-6)	9 to 53 MC measuring range	
VTVM	0 to 22 vdc range	
Circuit Board Extender (Singer Model 1866)		
Oscilloscope		

TABLE 11-2. HO ADJUSTMENTS

DISPLAY FREQUENCY (MC)	HO FREQUENCY (MC)	ADJUSTMENT	DISPLAY FREQUENCY (MC)	HO FREQUENCY (MC)	ADJUSTMENT
0	12	C100	25	29	C82
1	13	C101	26	30	C83
2	14	L3	27	31	C84
3	15	L2	28	32	C85
4	16	L1	29	33	C86
5	9	C97	30	34	C67
6	10	C98	31	35	C68
7	11	C99	32	36	C69
8	12	C100	33	37	C70
9	13	C101	34	38	C71
10	14	C87	35	39	C72
11	15	C88	36	40	C73
12	16	C89	37	41	C74
13	17	C90	38	42	C75
14	18	C91	39	43	C76
15	19	C92	40	44	C57
16	20	C93	41	45	C58
17	21	C94	42	46	C59
18	22	C95	43	47	C60
19	23	C96	44	48	C61
20	24	C77	45	49	C62
21	25	C78	46	50	C63
22	26	C79	47	51	C64
23	27	C80	48	52	C65
24	28	C81	49	53	C66

TABLE 11-3. TYPICAL DC VOLTAGES

CONDITIONS:

a. Supply voltages of -22 ±1 vdc, 15 ±1 vdc, and +22 ±1 vdc.

b. Measured with VTVM.

TRANSISTOR	BASE	EMITTER
Q1	4	3.6
Q2	10	11.8
Q3	6.6	3.8
Q4	4.3	3.8
Q5	15	15

TABLE 11-3. TYPICAL DC VOLTAGES (CONT)

TRANSISTOR	BASE	EMITTER
Q6	6.1	5.2
Q7	5.1	4.5
Q8	5.1	4.5
Q9	5.7	5.2
Q10	-10	-8
Q11	-9.8	-7.8
Q12	-12.5	-11.5
Q13	-11.5	-12
Q14	-11.5	-11.5

REF DESIG	ITEM	MFR	PART NO.
C63	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C64	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C65	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C66	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C67	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C68	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C69	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C70	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C71	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C72	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C73	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C74	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C75	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C76	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C77	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C78	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C79	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C80	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C81	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C82	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C83	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C84	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C85	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C86	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C87	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C88	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C89	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C90	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C91	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C92	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C93	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C94	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402

REF DESIG	ITEM	MFR	PART NO.
C95	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C96	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C97	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C98	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C99	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C100	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C101	Capacitor, trimmer, 1.5 to 20 pf	Elmenco	402
C102	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C103	Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
C104	Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
C105	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
C106	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
C107	Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
C108	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C109	Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
C110	Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
C111	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
C112	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
C113	Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
C114	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C115	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C116	Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
C117	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
C118	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C119	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
C120	Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
CR1	Diode		1N273
CR2	Diode		1N273
CR3	Diode		1N273
CR4	Diode		1N273
CR5	Diode		1N273
CR6	Diode		1N273

REF DESIG	ITEM	MFR	PART NO.
CR7	Diode		1N273
CR8	Diode, capacitive reactance	Philco	V4090
CR9	Diode, capacitive reactance	Philco	V4090
CR10	Diode, capacitive reactance	Philco	V4090
CR11	Diode, capacitive reactance	Philco	V4090
CR12	Diode, capacitive reactance	Philco	V4090
L1	Coil	Singer	LR-26-6
L2	Coil	Singer	LR-26-7
L3	Coil	Singer	LR-26-8
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N984
Q4	Transistor		2N984
Q5	Transistor		2N984
Q6	Transistor		2N2924
Q7	Transistor		2N2925
Q8	Transistor		2N2925
Q9	Transistor		2N2924
Q10	Transistor		2N3563
Q11	Transistor		2N3563
Q12	Transistor		2N3563
Q13	Transistor		2N2924
Q14	Transistor		2N2924
R1	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 220K ±10%, 1/4W		
R3	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R4	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R5	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R6	Resistor, fixed, composition, 22K ±10%, 1/4W		
R7	Resistor, fixed, composition, 10K ±10%, 1/4W		
R8	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R9	Resistor, fixed, composition, 10K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R10	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		
R11	Resistor, fixed, composition, 1K ±10%, 1/4W		
R12	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R13	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R14	Resistor, fixed, composition, 220K ±10%, 1/4W		
R15	Resistor, fixed, composition, 18K ±10%, 1/4W		
R16	Resistor, fixed, composition, 22K ±10%, 1/4W		
R17	Resistor, fixed, composition, 10K ±10%, 1/4W		
R18	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R19	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R20	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R21	Resistor, fixed, composition, 47K ±10%, 1/4W		
R22	Resistor, fixed, composition, 330 ohms ±10%, 1/4W		
R23	Resistor, fixed, composition, 820 ohms ±10%, 1/4W		
R24	Resistor, fixed, composition, 1K ±10%, 1/4W		
R25	Resistor, fixed, composition, 1K ±10%, 1/4W		
R26	Resistor, fixed, composition, 10K ±10%, 1/4W		
R27	Resistor, fixed, composition, 20K ±10%, 1/4W		
R28	Resistor, fixed, composition, 10K ±10%, 1/4W		
R29	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R30	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R31	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R32	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R33	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R34	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R35	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R36	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R37	Resistor, fixed, composition, 12K ±10%, 1/4W		
R38	Resistor, selected value, 10 to 100 ohms		
R39	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R40	Resistor, fixed, composition, 1K ±10%, 1/4W		
R41	Resistor, fixed, composition, 1.5K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R42	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R43	Resistor, fixed, composition, 10K ±10%, 1/4W		
R44	Resistor, selected value 10 to 100 ohms		
R45	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R46	Resistor, fixed, composition, 1K ±10%, 1/4W		
R47	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R48	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R49	Resistor, fixed, composition, 10K ±10%, 1/4W		
R50	Resistor, selected value 10 to 100 ohms		
R51	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R52	Resistor, fixed, composition, 1K ±10%, 1/4W		
R53	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R54	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R55	Resistor, fixed, composition, 12K ±10%, 1/4W		
R56	Resistor, selected value, 10 to 100 ohms		
R57	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R58	Resistor, fixed, composition, 1K ±10%, 1/4W		
R59	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R60	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R61	Resistor, fixed, composition, 12K ±10%, 1/4W		
R62	Resistor, selected value, 10 to 100 ohms		
R63	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R64	Resistor, fixed, composition, 1K ±10%, 1/4W		
R65	Resistor, fixed, composition, 1.5K ±10%, 1/4W		
R66	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R67	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R68	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R69	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R70	Resistor, selected value, may be omitted		
R71	Resistor, fixed, composition, 8.2K ±10%, 1/4W		
S1	Switch	Singer	OM-1497
S2	Switch	Singer	OM-1496-3

REF DESIG	ITEM	MFR	PART NO.
T1	Transformer	Singer	LR-27
T2	Transformer	Singer	LR-28
T3	Transformer	Singer	LR-6
T4	Transformer	Singer	LR-7
T5	Transformer	Singer	LR-8
T6	Transformer	Singer	LR-9
T7	Transformer	Singer	LR-10
TP1	Test Point	Ucinite	119437-H
TP2	Test Point	Ucinite	119437-H

SECTION XII

DEVIATION MODULE
A22

REF DESIG	DESCRIPTION	MFR	PART NO.
A23	IF Amplifier (See Section 13)	Singer	AA-1196
A24	Discriminator and Meter Drive (See Section 14)	Singer	AA-1197
H1	Knob	Singer	126-0019-001
H2	Knob	Singer	126-0025-001
J1	Connector	Viking	2VH15/1AB8
J2	Connector	Viking	2VH15/1AB8
J3	Jack, phone	Switchcraft	11
M1	Meter	Singer	MA-22
P4	Connector	Amphenol	26-159-16
S1, S2	Switch Assy	Singer	SW-301
R1	Resistor, fixed, composition, 22K ±10%, 1/4 watt		

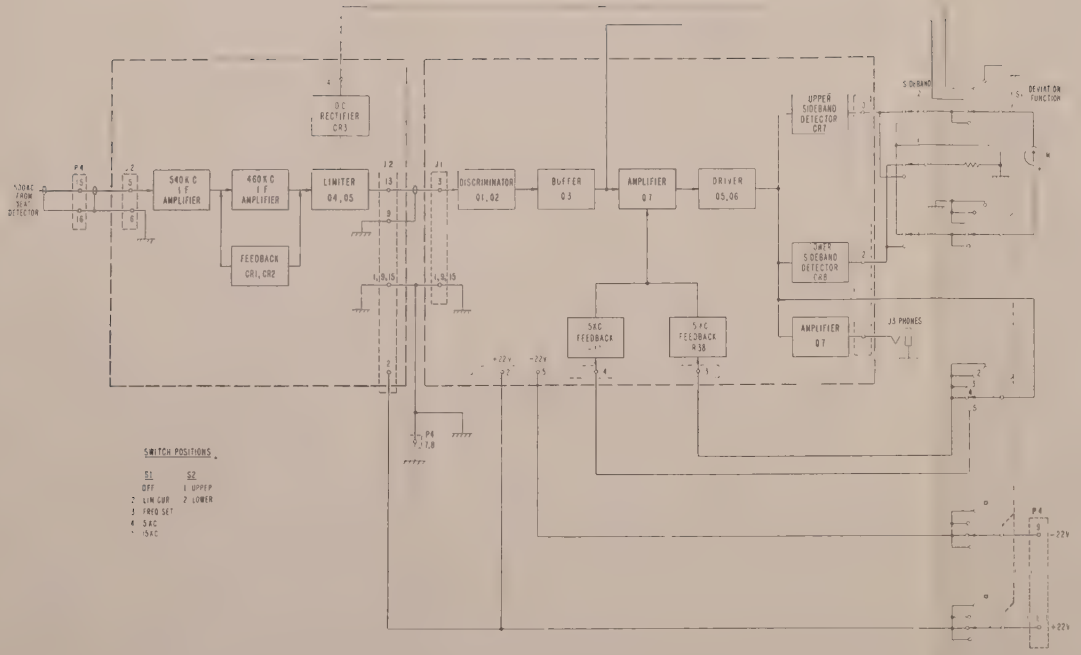


Figure 12-1. Schematic Diagram

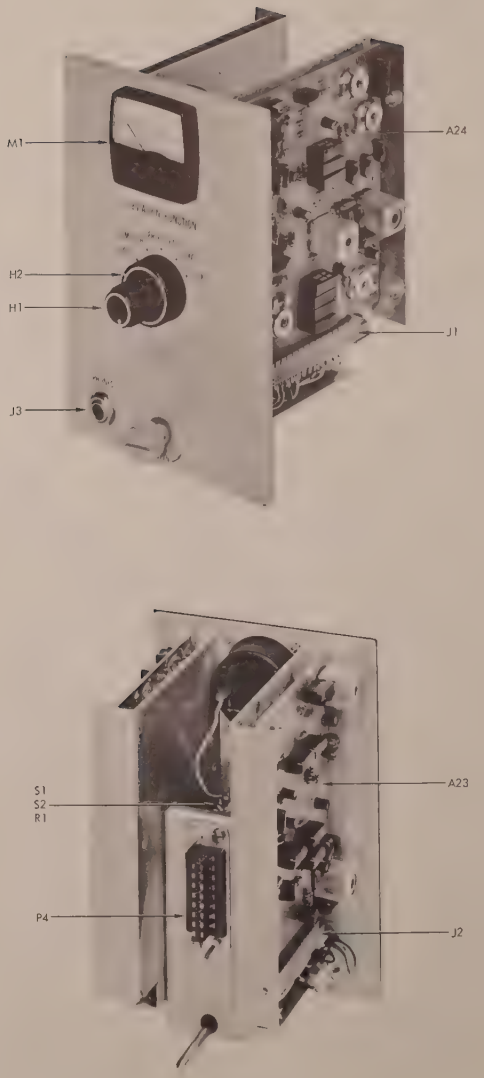


Figure 12-2. Parts Location View

12-1. GENERAL.

12-2. This section contains general information for the deviation module. For detail information on the individual circuit boards, refer to the following sections:

a. Section XIII for IF Amplifier A23

b. Section XIV for Discriminator and Meter Drive A24.

12-3. CIRCUIT DESCRIPTION.

12-4. When the Model SSG-1 is used as a deviation meter, the system functions essentially as a superheterodyne FM receiver. The discriminator has an IF frequency of 500 kc and an output voltage which is directly related to frequency deviation. The output of the discriminator is applied through the detector driver and audio amplifier to the speaker, and through the detector driver and either the upper or lower sideband detector to the meter.

12-5. The high frequency oscillator functions as the local oscillator and is controlled in the same manner as for frequency meter operation. When the high frequency oscillator is properly adjusted, the incoming signal and the high frequency oscillator signal are mixed in the beat detector and produce an IF signal of 500 kc. When the FUNCTION switch is turned to the FREQ SET position, the frequency adjustment may be checked. When the IF signal is set exactly to the 500 kc center frequency, the two sides of the discriminator produce equal and cancelling voltages. The meter then measures only a bias voltage (red line).

12-6. Amplitude variations in the input signal could cause erroneous indications. To eliminate this source of error the signal is amplified by two IF stages and then applied to the limiter. The limiter provides an output signal with an exact amplitude regardless of amplitude variations in the input signal. However, for the limiter to operate properly, a minimum input signal is required. The level of the input signal may be checked by turning the FUNCTION switch to the LIM CUR position. For this check, a special dc output of the limiter is applied directly to the meter. With sufficient input signal, the meter will deflect to a red line indication.

12-7. The detector driver, detector, and meter function as a peak reading voltmeter circuit. The output of the driver charges a capacitor to the peak voltages which are equivalent to peak frequency deviations. The capacitor discharges through a large resistor and the meter movement. The circuit is calibrated by setting the amount of feedback used in the detector driver circuit. One feedback circuit calibrates the meter for a full scale reading of 5 kc and a second circuit calibrates the meter for the 0 to 15 kc range.

12-8. TEST EQUIPMENT.

12-9. Refer to Table 12-1 for a list of test equipment.

12-10. CHECKOUT.

12-11. SENSITIVITY CHECK. To check sensitivity of the meter circuit, proceed as follows:

a. Connect FM generator to the MEAS INPUT connector. Operate generator at a convenient carrier frequency, such as 150 MC.

TABLE 12-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
FM Generator (Boonton 202B)	Carrier frequency as required	
	Calibrated output, 5 mv and above	
	Linear frequency modulation	
	External modulation capability	
Audio Oscillator (HP Model 200CD)	577.8 cps	For 5 KC modulation check
	1.7333 KC	For 15 KC modulation check
	Frequency accuracy - ±1%	
	Sinusoidal output	
	Continuously variable amplitude	
	Low harmonic content	
Extension Cable	Singer Model 1892	

b. Operate the Model SSG-1 as a frequency meter and set frequency to 500 kc below the carrier frequency (see Operation Book).

c. Turn DEVIATION FUNCTION switch to the LIM CUR position.

d. Adjust output of FM generator until the deviation meter deflects to between the red line and full scale.

e. Turn DEVIATION FUNCTION switch to the FREQ SET position.

f. Adjust decade frequency switches as required to set the deviation meter to the FREQ. SET red line. If a red line indication cannot be obtained, the most likely source of trouble is the discriminator stage of discriminator and meter drive A24.

g. Return DEVIATION FUNCTION switch to the LIM CUR position.

h. Starting from minimum, increase FM generator output until the deviation meter deflects to the red line.

i. The FM generator output should be 5 millivolts or less. If excessive output is required, the most likely sources of trouble are the beat detector A28 or the IF amplifier A23.

12-12. METER CALIBRATION CHECK. To check the full scale readings of the meter, proceed as follows (carrier null method):

a. Connect FM generator to the MEAS INPUT connector. Operate generator at a convenient carrier frequency and 5 mv output or more.

b. Connect audio oscillator to the external modulation input of the FM generator. Operate audio oscillator at 577.8 cps and zero amplitude.

c. Operate the Model SSG-1 as a frequency meter and zero beat against the carrier frequency (see Operation Manual).

d. Adjust Model SSG-1 to obtain a low but clearly audible beat frequency note. A beat note of approximately 200 to 300 cps should provide adequate results. Use headset to monitor beat note.

e. Increase amplitude of audio oscillator until the beat note against carrier disappears. Amplitude should be increased slowly and the beat note should be monitored carefully to make certain that the correct beat note disappearance is selected.

f. Continue increasing amplitude until the third disappearance of the beat note against carrier occurs. Carefully adjust amplitude to center the control in the range of the beat note disappearance. At this point, the FM generator is operating with a deviation of 5 kc.

g. Reset the Model SSG-1 to a frequency 500 kc below the carrier frequency of the FM generator.

h. Turn DEVIATION FUNCTION switch to the FREQ SET position.

i. Operate the FM generator with no modulation applied. This may be accomplished by disconnecting the audio oscillator. Do not change frequency or amplitude settings of audio oscillator.

j. Adjust decade frequency switches of Model SSG-1 as required to set the deviation meter to the FREQ. SET red line.

k. Turn DEVIATION FUNCTION switch to the 5 KC position.

l. Turn SIDEBAND switch to the UPPER position.

m. Apply modulation to the FM generator.

n. The peak deviation meter should indicate 5 kc ±5%.

o. Reset the Model SSG-1 to a frequency 500 kc above the carrier frequency of the FM generator. Repeat steps h, i, j, and k.

p. The peak deviation meter should indicate 5 kc ±5%.

(1) If the readings of steps n and p differ, this indicates trouble in the input signal (distortion, unequal sidebands, etc.).

(2) If the readings are equal but out of specification, the most probable source of trouble is the discriminator and meter drive A24.

q. Turn SIDEBAND switch to the LOWER position.

r. The peak deviation meter should indicate 5 kc ±5%.

s. Connect headset to the PHONES jack of the deviation module.

t. Check that audio signal of approximately 577.8 cps is present.

u. Repeat procedure for the 15 kc range using a modulation frequency of 1.7333 kc.

SECTION XIII

IF AMPLIFIER
A23

REF DESIG	DESCRIPTION	MFR	PART NO.
C1	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C2	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.01
C3	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C4	Capacitor, mica, 200 pf ±5%, 200V	Elmenco	DM15E201J
C5	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C6	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C7	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C8	Capacitor, mica, 330 pf ±10%, 200V	Elmenco	DM15E331J
C9	Capacitor, mica, 470 pf ±5%, 200V	Elmenco	DM15E471J
C10	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C11	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C12	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C13	Not Used		
C14	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C15	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C16	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C17	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
CR1	Diode		1N914
CR2	Diode		1N914
CR3	Diode		1N914
L1	Coil, variable	Wells	387-650
L2	Coil, variable	Wells	387-650
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
Q4	Transistor		2N2924
Q5	Transistor		2N2924
R1	Resistor, fixed, composition, 100K ±10%, 1/4 watt		
R2	Resistor, fixed, composition, 15K ±10%, 1/4 watt		
R3	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R4	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R5	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R6	Resistor, fixed, composition, 56 ohms ±10%, 1/4 watt		
R7	Resistor, fixed, composition, 47K ±10%, 1/4 watt		
R8	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R9	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R10	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R11	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R12	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R13	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R14	Resistor, fixed, composition, 8.2K ±10%, 1/4 watt		
R15	Resistor, variable, 5K	Mallory	MTC-4-5K
R16	Resistor, fixed, composition, 3.9K ±10%, 1/4 watt		
R17	Resistor, variable, 10K	Mallory	MTC-4-10K
R18	Resistor, fixed, composition, 3.3K ±10%, 1/4 watt		
R19	Resistor, fixed, composition, 270 ohms ±10%, 1/4 watt		
R20	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R21	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R22	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R23	Resistor, fixed, composition, 10 ohms ±10%, 1/4 watt		

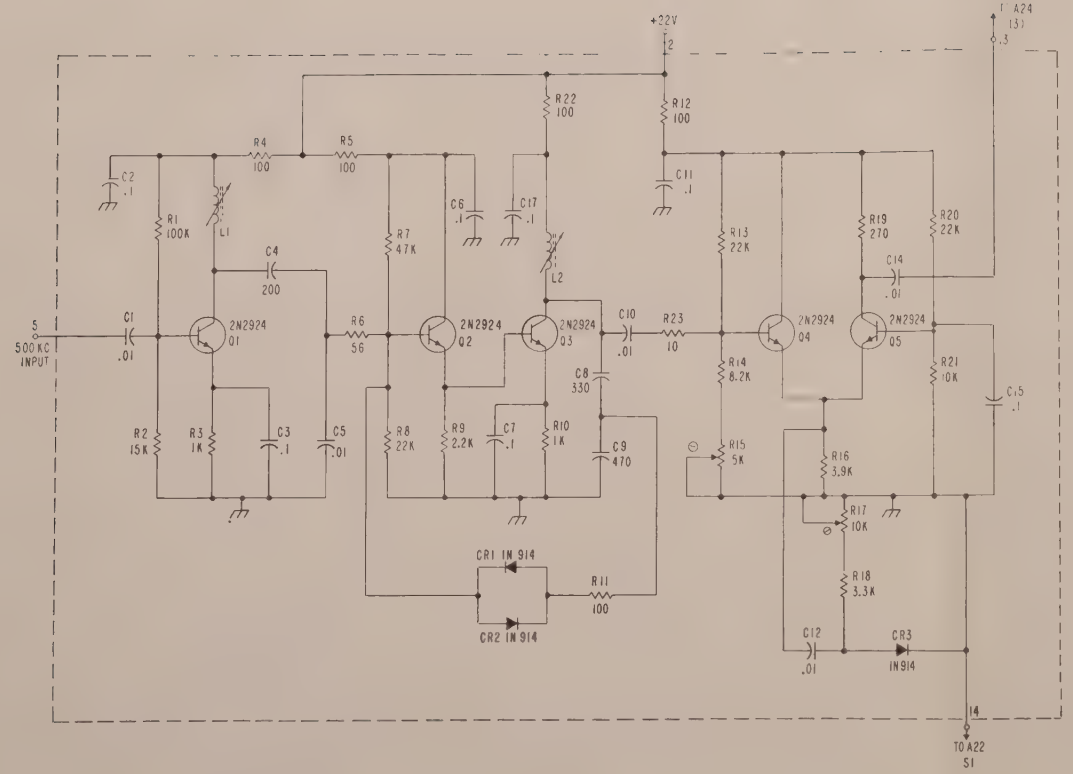


Figure 13-1. Schematic Diagram

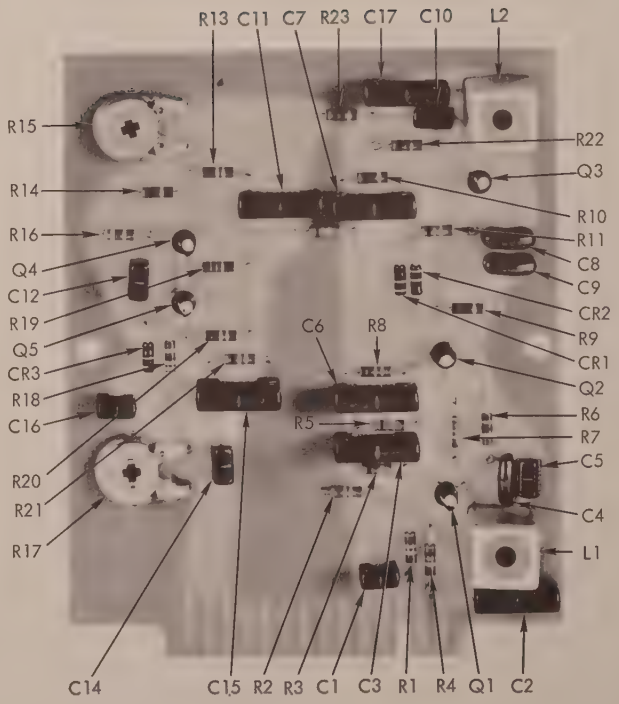


Figure 13-2. Parts Location View

13-1. CIRCUIT DESCRIPTION.

13-2. The IF amplifier receives a signal with a 500 KC center frequency from beat detector A28. The board assembly delivers an amplified and limited signal to discriminator and meter drive A24.

13-3. The two amplifier stages are stagger tuned to provide broad band amplification of a frequency modulated signal. Amplifier Q1 is tuned to 520 KC by coil L1. Two-stage amplifier Q2 and Q3 is tuned to 480 KC by coil L2. Diodes CR1 and CR2 provide negative feedback to stabilize and limit the stage.

13-4. Limiter Q4 and Q5 provides a square wave output with a fixed peak-to-peak amplitude. Through the common emitter coupling, the stages are alternately driven to maximum. When Q4 is operating at maximum, Q5 is operating at minimum and therefore the output from the stage is maximum positive. When Q4 is operating at minimum, Q5 is driven to maximum and therefore the output from the stage is minimum positive.

13-5. Resistor R15 adjusts the stage for a symmetrical output. The output applied through rectifier CR3 is used to check input level to the amplifier. Resistor R17 sets the output of the rectifier to a predetermined level.

13-6. TEST EQUIPMENT.

13-7. Refer to Table 13-1 for a list of test equipment.

13-8. ADJUSTMENTS.

13-9. To tune the amplifier stages, proceed as follows:

a. Connect signal generator to amplifier input (capacitor C1 or pin 5 of the connector).

b. Connect oscilloscope to the base of Q4.

c. Turn DEVIATION FUNCTION switch to the LIM CUR position.

d. Set signal generator to 480 KC and 50 μv.

e. Tune coil L2 for maximum signal output.

f. Set signal generator to 520 KC and 50 μv.

g. Adjust coil L1 for maximum signal output.

h. Set signal generator to 500 KC.

i. Increase signal generator output until the oscilloscope indicates an amplifier output of 4 volts peak-to-peak.

j. Check that generator output is 150 μv or less.

13-10. To adjust the limiter, proceed as follows:

a. Connect oscilloscope to the limiter output (C14 or pin 13).

b. Adjust resistor R15 as required to provide a symmetrical square wave output.

c. Make certain that the DEVIATION FUNCTION switch is set to the LIM CUR position.

d. Adjust resistor R17 as required until the meter deflects to the LIM CUR red line.

TABLE 13-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Signal Generator	480 to 520 KC	
	50 to 150 μv calibrated output	
Oscilloscope	480 to 520 KC	
	.4 to 4 volts peak-to-peak	

TABLE 13-2. TYPICAL DC VOLTAGES

CONDITIONS

a. Supply voltage set to 22 vdc.

b. Measured with VTVM.

c. No signal input.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	2.7	2.2	22
Q2	6.5	6	22
Q3	6	5.3	22
Q4	7-8	8	22
Q5	7-8	8	22

SECTION XIV

DISCRIMINATOR AND METER DRIVE
A24

REF DESIG	DESCRIPTION	MFR	PART NO.
C1	Capacitor, mica, 56 pf ±5%, 200V	Elmenco	DM15E560J
C2	Capacitor, mica, 250 pf ±5%, 200V	Elmenco	DM15E251J
C3	Capacitor, mica, 100 pf ±5%, 200V	Elmenco	DM15E101J
C4	Capacitor, mica, 330 pf ±5%, 200V	Elmenco	DM15E331J
C5	Capacitor, electrolytic, 0.1 uf ±20%, 35V	Goodall	931-.47-35-20
C6	Capacitor, mica, 330 pf ±5%, 200V	Elmenco	DM15E331J
C7	Capacitor, mica, 200 pf ±5%, 200V	Elmenco	DM15E201J
C8	Capacitor, mica, 56 pf ±5%, 200V	Elmenco	DM15E560J
C9	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C10	Capacitor, electrolytic, 0.47 uf ±20%, 35V	Goodall	931-.47-35-20
C11	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C12	Capacitor, mica, 75 pf ±5%, 200V	Elmenco	DM15E750J
C13	Capacitor, mica, 130 pf ±5%, 200V	Elmenco	DM15E131J
C14	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C15	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C16	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C17	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C18	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C19	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C20	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C21	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C22	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C23	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C24	Capacitor, electrolytic, 47 uf ±20%, 25 V	Goodall	931-47-25-20
C25	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR330-0.1
CR1	Diode		1N273
CR2	Diode		1N273
CR3	Diode		1N273
CR4	Diode		1N273
CR5	Diode		1N914
CR6	Diode		1N914
CR7	Diode		1N914
CR8	Diode		1N914
L1	Coil, variable	Wells	887-650
L2	Coil, variable	Wells	887-650
L3	Coil, 2.5 mh	Miller	70F253A1
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
Q4	Transistor		2N2924
Q5	Transistor		2N2924
Q6	Transistor		2N2924
Q7	Transistor		2N2924
R1	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R2	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R3	Resistor, fixed, composition, 220 ohms ±10%, 1/4 watt		
R4	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R5	Resistor, fixed, composition, 8.2K ±10%, 1/4 watt		
R6	Resistor, variable, 1K	Mallory	MTC-4-1K
R7	Resistor, fixed, composition, 470 ohms ±10%, 1/4 watt		
R8	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R9	Resistor, variable	Mallory	MTC-4-5K
R10	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R11	Resistor, fixed, composition, 220 ohms ±10%, 1/4 watt		
R12	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R13	Resistor, variable, 500 ohms	Mallory	MCT-4-500
R14	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R15	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R16	Resistor, fixed, composition, 220 ohms ±10%, 1/4 watt		

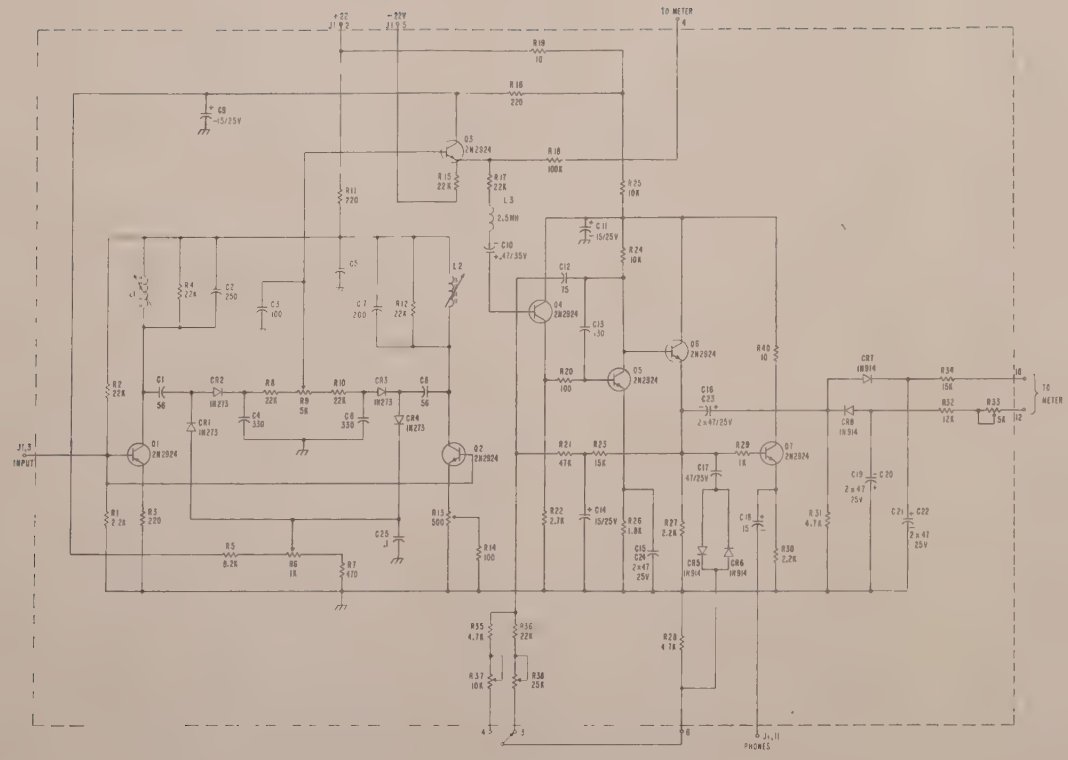


Figure 14-1. Schematic Diagram

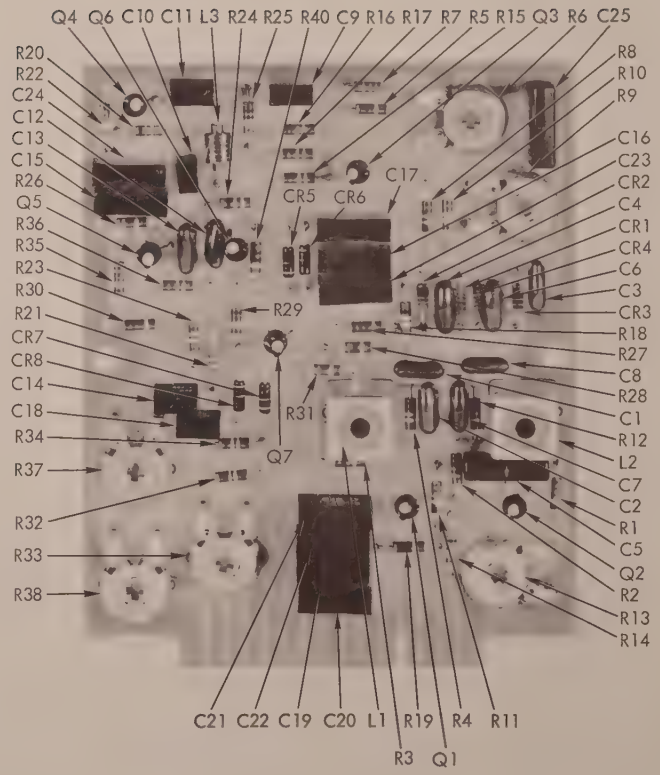


Figure 14-2. Parts Location View

REF DESIG	DESCRIPTION	MFR	PART NO.
R17	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R18	Resistor, fixed, composition, 100K ±10%, 1/4 watt		
R19	Resistor, fixed, composition, 10 ohms ±10%, 1/4 watt		
R20	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R21	Resistor, fixed, composition, 27K ±10%, 1/4 watt		
R22	Resistor, fixed, composition, 2.7K ±10%, 1/4 watt		
R23	Resistor, fixed, composition, 15K ±10%, 1/4 watt		
R24	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R25	Resistor, fixed, composition, 10 ohms ±10%, 1/4 watt		
R26	Resistor, fixed, composition, 1.8K ±10%, 1/4 watt		
R27	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R28	Resistor, fixed, composition, 4.7K ±10%, 1/4 watt		
R29	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R30	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R31	Resistor, fixed, composition, 4.7K ±10%, 1/4 watt		
R32	Resistor, fixed, composition, 12K ±10%, 1/4 watt		
R33	Resistor, variable, 5K	Mallory	MTC-4-5K
R34	Resistor, fixed, composition, 15K ±10%, 1/4 watt		
R35	Resistor, fixed, composition, 4.7K ±10%, 1/4 watt		
R36	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R37	Resistor, variable, 10K	Mallory	MTC-4-10K
R38	Resistor, variable, 25K	Mallory	MTC-4-25K
R39	Not Used		
R40	Resistor, fixed, composition, 10 ohms		

14-1. CIRCUIT DESCRIPTION.

14-2. The discriminator receives a signal with a center frequency of 500 KC from IF amplifier A23. This signal is converted to an audio signal with an amplitude determined by the amount of frequency deviation from the center frequency. The board assembly also delivers an audio signal to the head phone jack.

14-3. The input signal is applied to the two sides of the discriminator through transistors Q1 and Q2. The low side Q1 is tuned to 460 KC by coil L1 and the high side Q2 is tuned to 540 KC by coil L2. The outputs of the two transistors are applied to the voltage doubler circuit formed by diodes CR1, CR2, CR3, and CR4. The rectifier circuit is referenced to a dc level by resistor R6 and diodes CR1 and CR4.

14-4. At the center frequency of 500 KC, the signals developed by the two sides are equal and therefore the audio output is zero. As the frequency deviates, one side or the other will develop a greater signal and therefore an audio output. The amplitude of the audio signal is determined by the amount of deviation from the center frequency. Resistor R13 adjusts for any difference in output between the two transistors. Resistor R9 sets the output to the center of the rectifier circuit.

14-5. The audio signal is applied to the meter drive circuits through buffer Q3. The frequency set output is applied from the buffer through resistor R18. With a center frequency of 500 KC and with the discriminator adjusted properly, this dc output should cause a meter deflection to the FREQ SET line.

14-6. A three stage audio amplifier consisting of transistors Q4, Q5, and Q6 is used to drive the voltmeter circuits. Direct coupling is used between stages and degenerative feedback stabilizes gain. The voltmeter circuit is calibrated by setting gain and gain is determined by setting feedback. Resistor R38 calibrates the meter for a full scale indication of 5K and resistor R37 calibrates the meter for 15 KC.

14-7. Two peak reading voltmeter circuits are included for detection of upper and lower sidebands. Capacitors C21 and C22 are charged to a peak value through diode CR7 and slowly discharge through resistor R34 and the meter movement. Capacitors C19 and C20 are discharged through diode CR8 and slowly recharge through resistors R32 and R33 and through the meter movement. Resistor R33 adjusts the lower sideband circuit to equal the upper sideband circuit with symmetrical deviation.

14-8. The demodulated audio is applied to PHONES jack J1 through emitter follower Q7.

14-9. TEST EQUIPMENT.

14-10. Refer to Table 14-1 for a list of test equipment.

14-11. ADJUSTMENTS.

14-12. To adjust the discriminator, proceed as follows:

a. Connect FM generator to the MEAS INPUT connector. Set generator to a convenient carrier frequency and an output of 500 μv or above.

b. Operate the Model SSG-1 as a frequency meter and set frequency to 500 KC below the carrier frequency.

c. Turn DEVIATION FUNCTION switch to the LIM CUR position.

TABLE 14-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
FM Generator	450 to 500 KC sweep	
	Carrier frequency as required	
	Linear frequency modulation	
	External modulation capability	
Audio Oscillator	100 cps to 1.7333 KC	
	Frequency accuracy - ±1%	
	Sinusoidal output	
	Continuously variable amplitude	
	Low harmonic content	
Oscilloscope	450 to 500 KC	
Signal Generator	460 to 540 KC	Used to produce a frequency marker

d. Adjust output of FM generator until the deviation meter deflects to between the red line and full scale.

e. Connect scope vertical to the output of buffer Q3 (pin 4 of J1).

f. Connect audio oscillator to the external modulator input of the FM generator and to the horizontal scope drive. Set audio oscillator to approximately 100 cps.

g. Adjust the FM generator to sweep from 450 to 550 KC.

h. Loosely couple the signal generator to the input. See figure 14-3 for the complete test setup.

i. Set marker frequency to 460 KC.

j. Adjust coil L1 to produce a maximum output at the 460 KC marker (see figure 14-4).

k. Set marker frequency to 540 KC.

l. Adjust coil L2 to produce a maximum output at the 540 KC marker.

m. Adjust resistor R13 to produce a symmetrical discriminator output curve.

n. Repeat steps i through m as required to produce a linear output between 460 and 540 KC.

o. Disconnect audio oscillator, FM generator, and oscilloscope.

p. Connect signal generator to the input of the IF amplifier (pin 5 of the IF amplifier connector).

q. Set signal generator to 500 KC and 150 μv.

r. Turn DEVIATION FUNCTION switch to the LIM CUR position.

s. Make certain that the deviation meter deflects to the LIM CUR red line.

t. Turn DEVIATION FUNCTION switch to the FREQ SET position.

u. Adjust resistor R6 as required to set the deviation meter to the FREQ. SET red line.

14-13. To adjust the meter circuits, proceed as follows:

a. Set up test equipment as outlined in paragraph 12-12, steps a through n.

b. Adjust resistor R37 as required to set the deviation meter to 5 KC.

c. Turn SIDEBAND switch to the LOWER position.

d. Adjust resistor R33 as required to set the deviation meter to 5 KC.

e. Set up test equipment as outlined in paragraph 12-12, step u.

f. Adjust resistor R38 as required to set the deviation meter to 15 KC.

TABLE 14-2. TYPICAL DC VOLTAGES

CONDITIONS

a. Supply voltages of +22.0 and -22.0 vdc.

b. Measured with VTVM.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	1.5	1.2	22
Q2	1.5	1.2	22
Q3	*	*	22
Q4	3	2.5	22
Q5	2.5	2	10.5
Q6	10.5	9	22
Q7	9	8.5	22

*See Table 14-3.

TABLE 14-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	J1, pin 2	VTVM	+22 vdc ±1 vdc	
2. - Supply Voltage	J1, pin 5	VTVM	-22 vdc ±1 vdc	
3. Input Signal	J1, pin 3	Scope	Approximately square wave. 0.4V peak-to-peak	Unmodulated 500 KC input to IF amplifier
4. Q1 Output	Collector Q1	WIDE BAND Scope	12V peak-to-peak	
5. Q2 Output	Collector Q2	WIDE BAND Scope	12V peak-to-peak	Measurement should be equal to Q1 output (step 4)
6. Q3 Output	Emitter Q3	WIDE BAND Scope	1.5 vdc	Unmodulated 500 KC input
			4V peak-to-peak	15 KC modulation applied
7. Output to Meter	Emitter Q6	WIDE BAND Scope	2 volt peak-to-peak, approximately sine wave	15 KC modulation applied

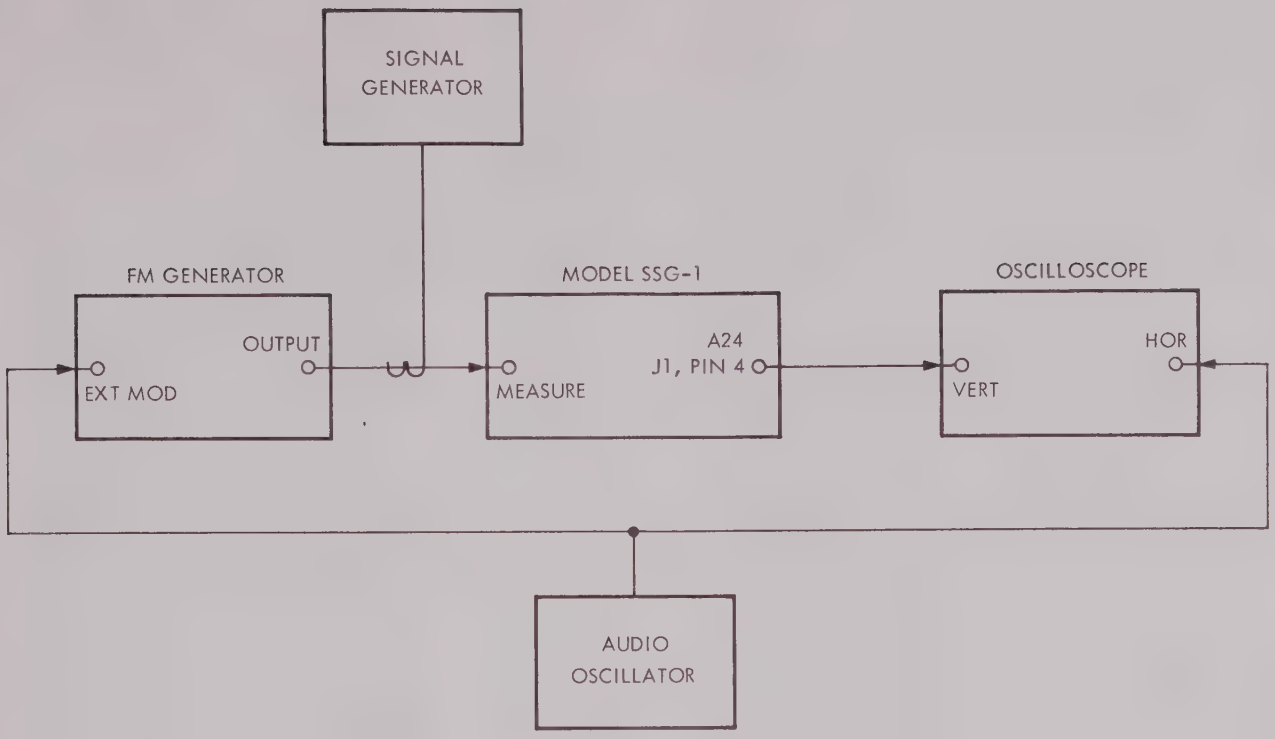


Figure 14-3. Adjustment Setup

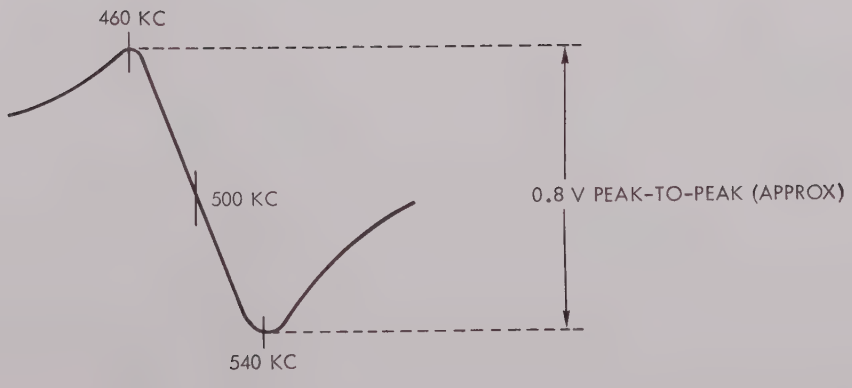


Figure 14-4. Discriminator Output Signal

SECTION XV

MODULATOR MODULE
A25

REF DESIG	DESCRIPTION	MFR	PART NO.
A26	Modulation Circuit (See Section 16)	Singer	AA-1198
A27	Modulation Meter (See Section 17)	Singer	AA-1199
H1	Knob	Singer	126-0019-001
H2	Knob	Singer	126-0025-001
J1	Connector	Viking	2V15H/1AB8
J2	Connector	Viking	2V15H/1AB8
J3	Connector, BNC		UG-657/U
M1	Meter	Singer	MA-23
P4	Connector	Amphenol	26-159-16
R1	Resistor, variable, 10K	CTS	53306
S1	Switch (includes R1)	Singer	SW-282

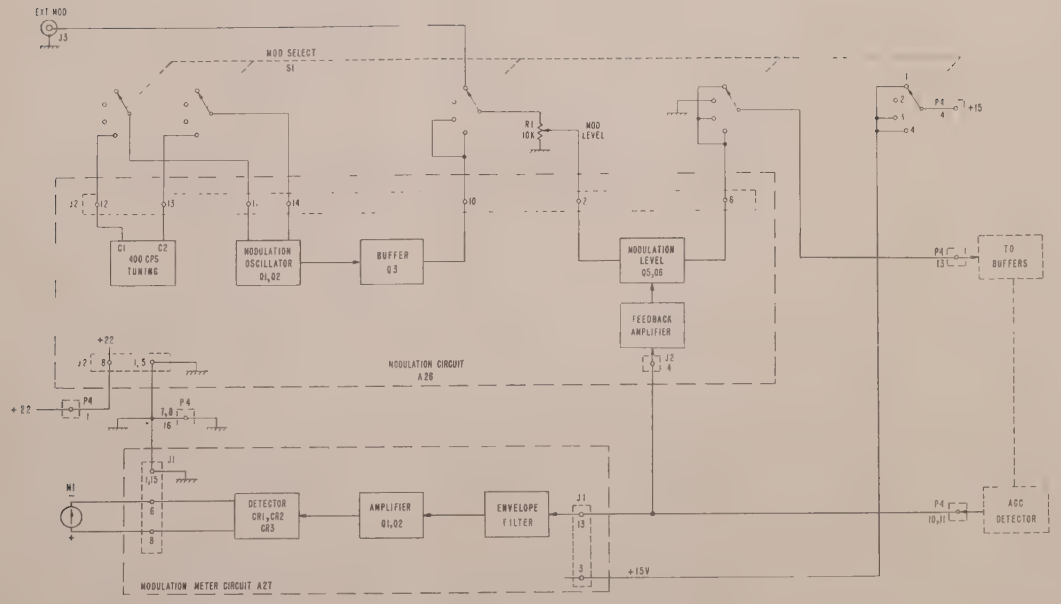


Figure 15-1. Schematic Diagram

Figure 15-2. Parts Location View

15-1. GENERAL.

15-2. This section contains general information on the modulation module. For detail information on the individual circuit boards, refer to the following sections:

a. Section XVI for Modulation Circuit A26

b. Section XVII for Modulation Meter Circuit A27.

15-3. CIRCUIT DESCRIPTION.

15-4. The modulation module applies amplitude modulation to the output signal and includes the meter circuit required to monitor the modulation level.

15-5. Modulation from the modulation oscillator or from an external source is applied to the output signal through the modulation amplifier. MOD LEVEL resistor R1 provides adjustment of the signal level into the amplifier.

15-6. Modulation level is read on the modulation level meter which receives its signal through the AGC detector. The envelope filter removes the high frequency component and the resultant signal is applied to the meter detector through an amplifier. Negative feedback from the output to the modulation amplifier is used to minimize distortion in the output signal.

15-7. TEST EQUIPMENT.

15-8. Refer to Table 15-1 for a list of test equipment.

15-9. CHECKOUT.

15-10. To checkout the modulation module, proceed as follows:

a. Set Model SSG-1 output frequency to 25 MC.

b. Connect modulation meter to the RF output connector. Tune meter to 25 MC.

c. Connect counter to the audio output of the modulation meter.

d. Set MOD SELECT switch to 400 ~.

e. Adjust MOD LEVEL resistor until the PERCENT MODULATION meter indicates 50% modulation.

f. Check that external modulation meter indicates 50% modulation ±5%.

(1) If 50% modulation cannot be obtained, the trouble is probably in modulation circuit A23.

(2) If 50% modulation can be obtained but the PERCENT MODULATION meter indication is out of specification, the trouble is probably in modulation meter circuit A24.

g. Check that counter indicates an output frequency of 400 cps ±5%.

h. Set MOD SELECT switch to 1000 ~ and repeat steps e, f, and g.

i. Connect audio oscillator to EXT. MOD jack. Set audio oscillator to produce a 1 KC, 1 vrms output signal.

j. Set MOD SELECT switch to the EXT MOD position.

k. Check that 50% modulation can be obtained with the MOD LEVEL control.

l. Repeat steps j and k at 100 cps and 10 KC.

TABLE 15-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Audio Oscillator (HP200CD)	100 cps to 10 KC frequency range	
	1 vrms output	
Modulation Meter (Singer Model MM-120)	25 MC frequency	
	To measure up to 50% modulation	
	100 cps to 10 KC modulation frequency range	
Counter	400 cps and 1000 cps	

SECTION XVI

MODULATION CIRCUIT
A26

REF DESIG	DESCRIPTION	MFR	PART NO.
C1	Capacitor, mylar, 0.015 uf ±1%, 50V	Paktron	MR700-.015
C2	Capacitor, mylar, 0.015 uf ±1%, 50V	Paktron	MR700-.015
C3	Capacitor, mylar, 0.01 uf ±1%, 50V	Paktron	MR700-.01
C4	Capacitor, mylar, 0.01 uf ±1%, 50V	Paktron	MR700-.01
C5	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C6	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C7	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C8	Capacitor, electrolytic, 150 uf ±20%, 10V	Goodall	931-150-10-20
C9	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
C10	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C11	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C12	Capacitor, electrolytic, 150 uf ±20%, 10V	Goodall	931-150-10-20
C13	Capacitor, electrolytic, 6.8 uf ±20%, 35V	Goodall	931-6.8-35-20
C14	Capacitor, electrolytic, 15 uf ±20%, 35V	Goodall	931-15-35-20
DS1	Lamp, incandescant	GE	344
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
Q4	Transistor		2N2924
Q5	Transistor		2N2924
Q6	Transistor		2N2924
R1	Resistor, fixed, wirewound, 15.8K ±1%		RN60D1583
R2	Resistor, fixed, wirewound, 15.8K ±1%		RN60D1583
R3	Resistor, fixed, composition, 18K ±10%, 1/4 watt		
R4	Resistor, fixed, composition, 33K ±10%, 1/4 watt		
R5	Resistor, fixed, composition, 330 ohms ±10%, 1/4 watt		
R6	Resistor, variable, 500 ohms	Mallory	MTC-4-500
R7	Resistor, fixed, composition, 3.3K ±10%, 1/4 watt		
R8	Resistor, fixed, composition, 3.3K ±10%, 1/4 watt		
R9	Resistor, fixed, composition, 39K ±10%, 1/4 watt		
R10	Resistor, fixed, composition, 18K ±10%, 1/4 watt		
R11	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R12	Resistor, fixed, composition, 680 ohms ±10%, 1/4 watt		
R13	Resistor, fixed, composition, 47K ±10%, 1/4 watt		
R14	Resistor, fixed, composition, 47K ±10%, 1/4 watt		
R15	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt.		
R16	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R17	Resistor, fixed, composition, 47K ±10%, 1/4 watt		
R18	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R19	Resistor, fixed, composition, 2.7K ±10%, 1/4 watt		
R20	Resistor, fixed, composition, 220 ohms ±10%, 1/4 watt		
R21	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R22	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R23	Resistor, fixed, composition, 6.8K ±10%, 1/4 watt		

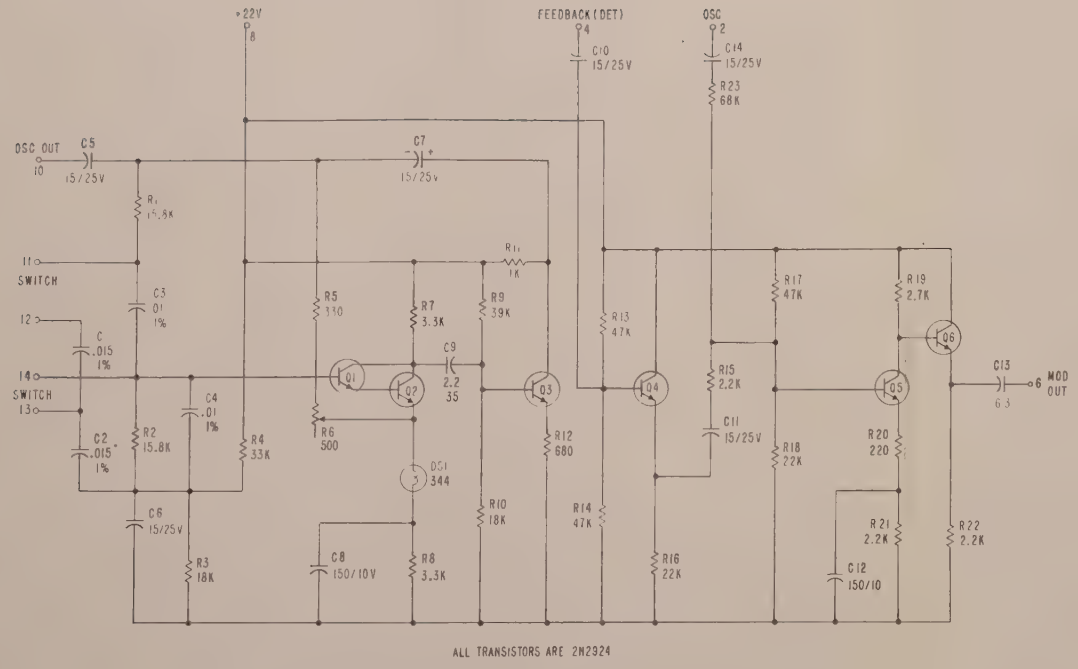


Figure 16-1. Schematic Diagram

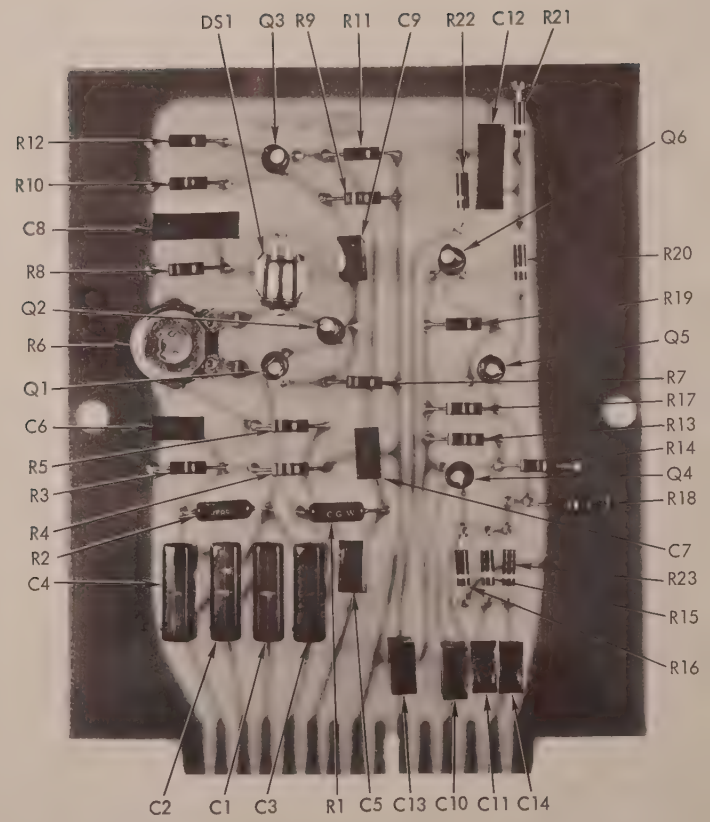


Figure 16-2. Parts Location View

16-1. CIRCUIT DESCRIPTION.

16-2. Transistors Q1, Q2, and Q3 form an RC type of oscillator (negative resistance) with both positive and negative feedback. For 1000 cps, the positive feedback from the output to the input is through the RC network consisting of resistors R1 and R2 and capacitors C3 and C4. At the selected frequency, the feedback through this path is maximum (since the phase shift through the series and parallel networks are approximately equal and of opposite sign). When the MOD SELECT switch is turned to the 400 ~ position, capacitors C1 and C2 are connected in parallel with capacitors C3 and C4. Capacity increases and therefore the frequency is lowered.

16-3. The negative feedback, applied to the emitter of Q2, is used to set gain and stabilize the output. The amount of feedback and thus gain is adjusted by resistor R6. Lamp DS1 is used as a variable resistive element. When gain through the oscillator is low, the amount of current through the light is low and thus the emitter resistance is low. As gain increases the resistance increases thus effectively increasing the amount of negative feedback.

16-4. The modulation from the MOD LEVEL resistor is amplified by transistors Q5 and Q6 and applied to the output signal through the applicable buffer. Negative feedback from the output signal is applied to the amplifier through emitter follower Q4.

16-5. TEST EQUIPMENT.

16-6. Refer to Table 16-1 for a list of test equipment.

16-7. ADJUSTMENT.

16-8. To adjust the output of the oscillator, proceed as follows:

a. Connect oscilloscope and counter to the oscillator output (pin 10 of J2 or C5).

b. Turn DEVIATION FUNCTION switch to 400~.

c. Check that output signal is 5 volts peak-to-peak and an undistorted sine wave. If required, adjust resistor R6 to obtain output.

d. Check that output frequency is 400 cps ±5%.

e. Repeat steps b, c, and d at 1000~. Any troubles are probably in the oscillator circuit.

16-9. TEST.

16-10. To test the amplifier circuit, proceed as follows:

a. Connect audio oscillator to the EXT MOD jack. Set audio oscillator to 1 KC.

b. Connect oscilloscope to the amplifier output (pin 6 of J2 or C13).

c. Set MOD LEVEL resistor to maximum.

d. Starting from minimum, increase output of audio oscillator until the oscilloscope indicates an output signal of 5 volts peak-to-peak.

e. Check that the input voltage is equal to or less than 1 vrms. If excessive input is required, measure amount of feedback applied to Q4 (pin 4 of J2 or C10). For a 5V peak-to-peak output, the feedback should be approximately .5 volts peak-to-peak. If the feedback ratio is incorrect, the trouble is probably in the output circuit. Other troubles are probably the result of a defective amplifier.

TABLE 16-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	400 and 1000 cps	
	1 to 5V peak-to-peak amplitudes	
Counter	400 and 1000 cps	
	5V peak-to-peak	
Audio Oscillator	1000 cps	
	1 vrms	
Extension Cable	Singer Model 1892	

TABLE 16-2. TYPICAL DC VOLTAGES

CONDITIONS

a. Measured with VTVM.

b. Supply voltage of 22 ±0.1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	-	7.5	14
Q2	7.5	7	14
Q3	-	6	13
Q4	-	9.5	22
Q5	-	6	14.5
Q6	14.5	14	22

SECTION XVII

MODULATION METER CIRCUIT
A27

REF DESIG	DESCRIPTION	MFR	PART NO.
C1	Capacitor, mica, 750 pf ±5%	Elmenco	DM15E751J
C2	Capacitor, mica, 1500 pf ±5%	Elmenco	DM19E152J
C3	Capacitor, mica, 750 pf ±5%	Elmenco	DM15E751J
C4	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C5	Capacitor, electrolytic, 220 uf ±20%, 6V	Goodall	931-220-6-20
C6	Capacitor, mylar, 0.001 uf ±10%, 50V	Paktron	MR330-.001
C7	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C8	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C9	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C10	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
CR1	Diode		1N914
CR2	Diode		1N457
CR3	Diode		1N914
L1	Coil, 150 mh	Collins	MIC-29
L2	Coil, 150 mh	Collins	MIC-29
Q1	Transistor		2N2924
Q2	Transistor		2N2924
R1	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R2	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R3	Resistor, fixed, composition, 47K ±10%, 1/4 watt		
R4	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R5	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R6	Resistor, fixed, composition, 4.7K ±10%, 1/4 watt		
R7	Resistor, fixed, composition, 4.7K ±10%, 1/4 watt		
R8	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R9	Resistor, variable, 1K	Mallory	MTC-4-1K
R10	Resistor, fixed, composition, 330 ohms ±10%, 1/4 watt		
R11	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		

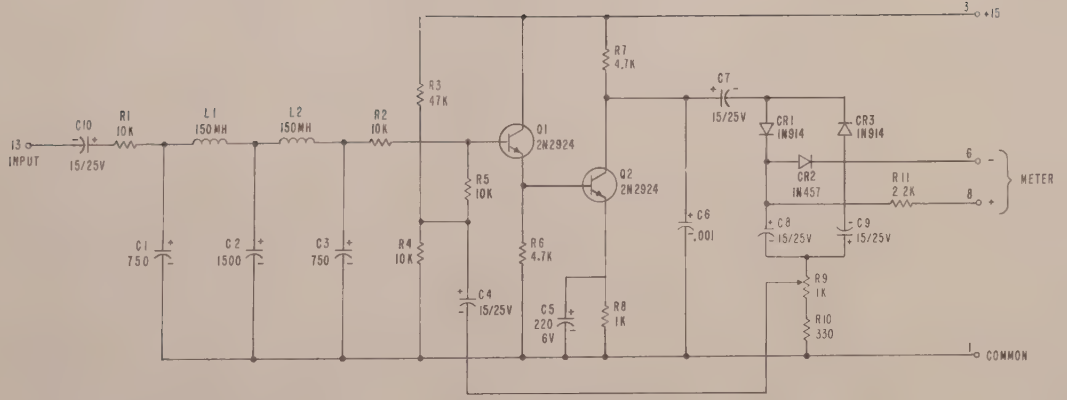


Figure 17-1. Schematic Diagram

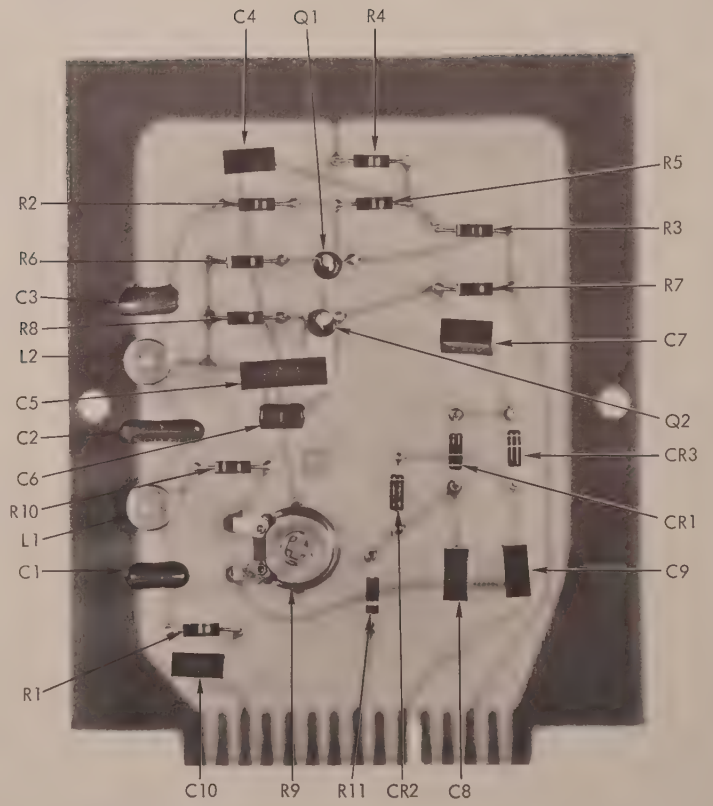


Figure 17-2. Parts Location View

17-1. CIRCUIT DESCRIPTION.

17-2. A sample of the output signal is applied to the modulation meter through the input filter, amplifier Q1 and Q2, and the full wave rectifier circuit CR1 and CR3. The meter circuit is calibrated by setting the gain of the amplifier. Setting the gain is accomplished by selecting the amount of feedback through resistor R9.

17-3. The input filter (C1, C2, C3, L1, L2) provides a 100 cps to 10 KC pass band and thus eliminates the high frequency component of the input signal. The -3 db points for the filter are approximately 10 cps and 18.5 KC. The output of the filter is applied to the meter circuit through amplifier Q1 and Q2.

17-4. The modulation meter is connected into the full wave rectifier circuit formed by diodes CR1 and CR3. During one half cycle, diode CR3 conducts and applies a negative voltage to the negative side of the meter. During the alternate half cycle, diode CR1 conducts and applies a positive voltage to the other side of the meter.

17-5. TEST EQUIPMENT.

17-6. Refer to Table 17-1 for a list of test equipment.

17-7. ADJUSTMENT.

17-8. To adjust the meter circuit, proceed as follows:

a. Connect audio oscillator to the meter circuit input (pin 13 of J1 or C10). Set audio oscillator to an output of 1 KC and .5 volts peak-to-peak.

b. Turn MOD SELECT switch to CW. Do not apply an input to the EXT MOD jack.

c. Connect oscilloscope to the collector of Q2.

d. Adjust resistor R9 to obtain a 50% modulation (full scale) indication on the modulation.

e. Check that waveform at the collector of Q2 is approximately 1.2V peak-to-peak with a slightly rounded square wave.

TABLE 17-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Audio Oscillator	100 cps to 10 KC frequency	
	.5V peak-to-peak amplitude	
Oscilloscope	100 cps to 10 KC frequency	
	1.2V peak-to-peak amplitude	

TABLE 17-2. TYPICAL DC VOLTAGES

CONDITIONS

a. Measured with VTVM.

b. Supply voltage of 15 ±1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	-	2	15
Q2	2	1.4	8

SECTION XVIII

LEVEL SET MODULE
A19

REF DESIG	DESCRIPTION	MFR	PART NO.
A20	AGC Circuit (See Section 19)	Singer	AA-1194
A21	Audio Circuit (See Section 20)	Singer	AA-1195
H1	Knob	Singer	126-0019-001
H2	Knob	Singer	126-0025-001
H3	Knob	Singer	126-0019-001
J1	Connector	Viking	2VH15/1AB8
J2	Connector	Viking	2VH15/1AB8
J3	Jack, phone	Switchcraft	11
J5	Connector, BNC		UG-657/U
M1	Meter	Singer	MA-21
P4	Connector	Amphenol	26-153-16
R1	Resistor, variable, 500 ohms	CTS	53305
R2	Resistor, variable, 10K	Singer	RV-67
S1	Switch	Singer	SW-283

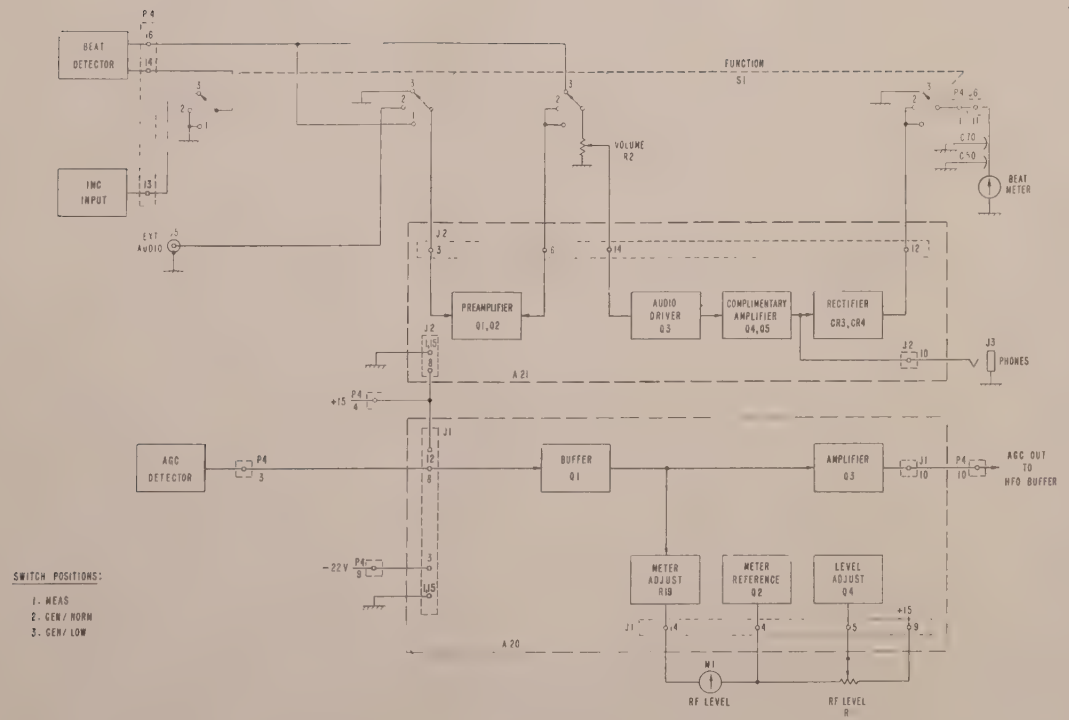


Figure 18-1. Schematic Diagram

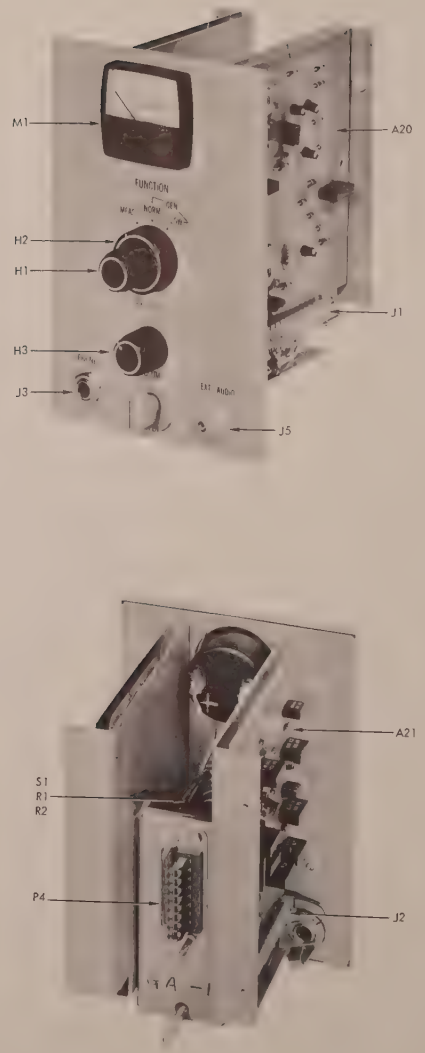


Figure 18-2. Parts Location View

18-1. GENERAL.

18-2. This section contains general information for the level set module. For detail information on the individual circuit boards, refer to the following sections:

a. Section XIX for AGC Circuit A20

b. Section XX for Audio Circuit A21.

18-3. CIRCUIT DESCRIPTION.

18-4. The level set module contains circuitry for two independent functions: the top part of the interconnection diagram (figure 18-1) shows the audio circuitry and the bottom part shows the AGC circuitry.

18-5. AUDIO. The audio circuit is essentially an audio amplifier which may be used to display beat notes or to amplify the low frequency output (5 cps to 10 KC). The system is designed for good response down to 1 cps beat notes.

18-6. With the FUNCTION switch in the MEAS position, beat notes from the beat detector are applied to the beat meter and PHONES jack J3. The audio level may be set using VOLUME control R2. With the FUNCTION switch in the GEN-NORM position, the audio system may be used with an external audio input. This position may be used to display beat notes from an external frequency multiplier-beat detector combination. With the FUNCTION switch in the GEN-LOW position, the audio system is used to amplify signals in the 5 cps to 10 KC range.

18-7. AGC. The AGC detector supplies a sample of the output signal level to the AGC circuit. The AGC circuit provides a dc voltage to the HFO buffer. The RF LEVEL resistor R1 controls AGC level and thus output level.

18-8. TEST EQUIPMENT.

18-9. Refer to Table 18-1 for a list of test equipment.

18-10. CHECKOUT, AGC CIRCUIT.

18-11. To checkout the AGC circuit, proceed as follows:

a. Connect microwave power meter to the RF OUTPUT jack. Use a six foot cable properly terminated with 50 ohms.

b. Set ATTENUATOR control 0 dbm.

c. Adjust Model SSG-1 to generate 25 MC.

d. Adjust RF LEVEL control as required to obtain a LEVEL SET indication on the RF OUTPUT meter.

e. Check that power meter indicates a 0 dbm output ±1 db.

f. Adjust RF LEVEL control as required to obtain a +7 dbm indication on the RF OUTPUT meter.

g. Check that power meter indicates a ±7 dbm output or more.

18-12. CHECKOUT, AUDIO CIRCUIT.

18-13. To checkout the audio circuit, proceed as follows:

a. Connect audio oscillator to the EXT. AUDIO connector. Adjust audio oscillator to produce a 1 KC, 125 μv signal.

b. Connect oscilloscope to the PHONES jack.

c. Turn FUNCTION switch to GEN-NORM.

d. Turn VOLUME control to maximum (CW).

e. Check that the output at the PHONES jack is 5 volts peak-to-peak or more and is a reasonably undistorted sine wave.

f. Repeat check with the audio oscillator set to 100 cps and 10 KC.

TABLE 18-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Audio Oscillator	5 cps to 10 KC frequency	
	125 μv to 2.5 mv output	
Oscilloscope	5 cps to 10 KC frequency	
	1 to 5V peak-to-peak	
Microwave Power Meter	25 MC frequency	
	0 dbm to ±7 dbm power	
Extension Cable	Singer Model 1892	

g. Adjust audio oscillator to produce a 5 cps, 125 μv signal.

h. Check that the output at the PHONES jack is 3 volts peak-to-peak or more and is a reasonably undistorted sine wave.

i. Check that the BEAT meter indicates a 5 cps beat note.

j. Turn FUNCTION switch to GEN-LOW.

k. Operate Model SSG-1 to produce a 100 cps signal.

l. Check that the output at the PHONES jack is 5 volts peak-to-peak or more and is a reasonably undistorted sine wave.

m. Turn FUNCTION switch to MEAS.

n. Connect a transmitter or signal generator to the MEAS INPUT connector. Operate signal source to provide a convenient carrier frequency.

o. Operate Model SSG-1 as a frequency meter to measure incoming signal.

p. Operate decade switches of the Model SSG-1 as required to provide a difference frequency of approximately 100 cps.

q. Check that beat note of approximately 100 cps is present at the PHONES jack.

SECTION XIX

AGC CIRCUIT
A20

REF DESIG	DESCRIPTION	MFR	PART NO.
C1	Capacitor, electrolytic, 47uf ±20%, 25V	Goodall	931-47-25-20
C2	Capacitor, electrolytic, 6.8uf ±20%, 25V	Goodall	931-6.8-25-20
C3	Capacitor, electrolytic, 6.8uf ±20%, 25V	Goodall	931-6.8-25-20
C4	Capacitor, mylar, 0.01uf ±10%, 50V	Paktron	MR330-.01
CR1	Diode		1N914
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
Q4	Transistor		2N2924
R1	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R2	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R3	Resistor, fixed, composition, 15K ±10%, 1/4 watt		
R4	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R5	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R6	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R7	Resistor, fixed, composition, 8.2K ±10%, 1/4 watt		
R8	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R9	Resistor, fixed, composition, 220 ohms ±10%, 1/4 watt		
R10	Resistor, variable, 1K	Mallory	MTC-4-1K
R11	Resistor, fixed, composition, 33K ±10%, 1/4 watt		
R12	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R13	Resistor, fixed, composition, 470 ohms ±10%, 1/4 watt		
R14	Resistor, fixed, composition, 6.8K ±10%, 1/4 watt		
R15	Resistor, fixed, composition, 4.7K ±10%, 1/4 watt		
R16	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R17	Resistor, fixed, composition, 3.3K ±10%, 1/4 watt		
R18	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R19	Resistor, variable, 5K	Mallory	MTC-4-5K

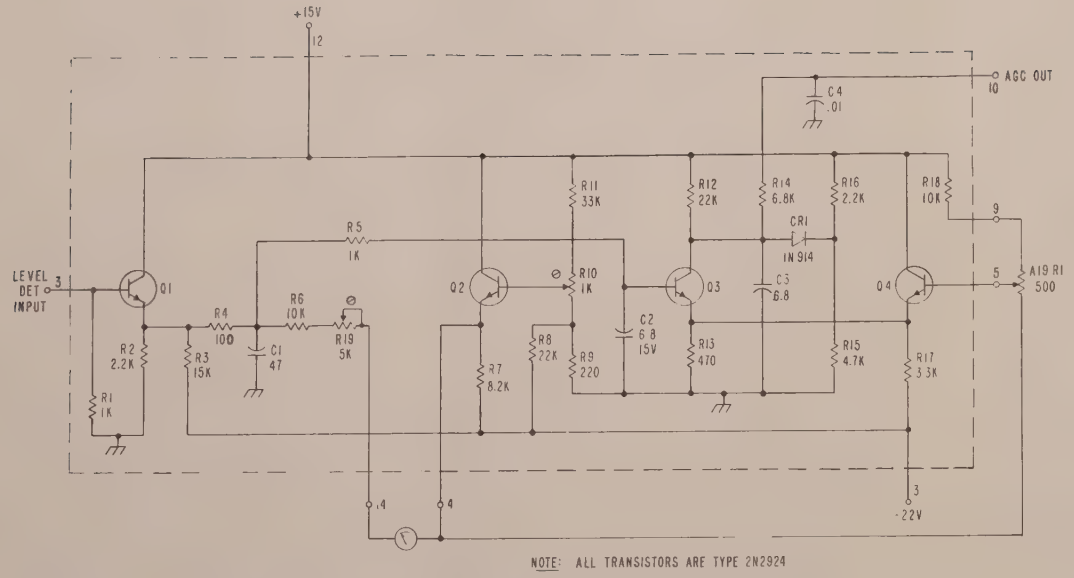


Figure 19-1. Schematic Diagram

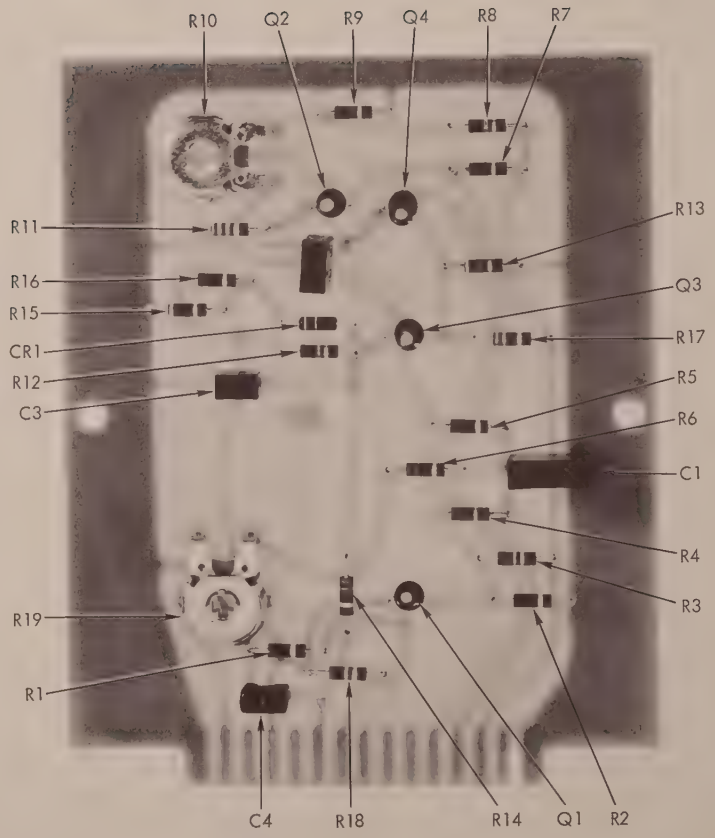


Figure 19-2. Parts Location View

19-1. CIRCUIT DESCRIPTION.

19-2. The AGC detector supplies a half-wave rectified signal to the AGC circuit. This signal is converted to a dc voltage which is applied to the HFO buffer.

19-3. The incoming signal is applied to buffer Q1 which in turn supplies a signal to the meter circuit and to dc amplifier Q3. The output of the buffer contains a dc filter consisting of capacitors C1 and C2 and resistor R5.

19-4. DC amplifier Q2 supplies the dc reference to one side of the RF LEVEL meter. Two resistors calibrate the meter circuit: resistor R10, operating through amplifier Q2, sets the dc reference voltage and resistor R19 adjusts the amount of current flow through the meter.

19-5. DC amplifier Q3 supplies the dc voltage to the HFO buffer. Level adjust Q4 controls the amount of dc voltage by controlling the bias on amplifier Q3. Diode CR1 limits the AGC output voltage to +10 volts.

19-6. TEST EQUIPMENT.

19-7. Refer to Table 19-1 for a list of test equipment.

19-8. ADJUSTMENTS.

19-9. To calibrate the meter circuit, proceed as follows:

a. Connect a jumper between the input and output (pin 3 to pin 10 of J1).

b. Connect vtvm to the output (pin 10 of J1).

c. Adjust RF LEVEL control to provide a +.25 vdc output.

d. Adjust resistor R10 as required to obtain a 0 dbm indication on the RF LEVEL meter.

e. Adjust RF LEVEL control to provide a +.5 vdc output.

f. Adjust resistor R19 as required to obtain a +7 dbm indication on the RF LEVEL meter.

g. Repeat steps c through f until the meter indicates 0 dbm with a +.25 vdc output and +7 dbm with a +.5 vdc output.

TABLE 19-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
VTVM	+.25 to .5 vdc	

TABLE 19-2. TYPICAL DC VOLTAGES

CONDITIONS

a. Measured with VTVM.

b. Supply voltages - +15 ±0.1 vdc and -22 ±0.1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	+.22	-.32	+15
Q2	+.05	-.5	+15
Q3	-.3	-.85	+8
Q4	-.3	-.85	+15

SECTION XX

AUDIO CIRCUIT
A21

REF DESIG	DESCRIPTION	MFR	PART NO.
C1	Capacitor, electrolytic, 220 uf ±20%, 6V	Goodall	931-220-6-20
C2	Capacitor, electrolytic, 6.8 uf ±20%, 35V	Goodall	931-6.8-35-2
C3	Not Used		
C4	Capacitor, mylar, 0.0047 uf ±10%, 50V	Paktron	MR330-.0047
C5	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C6	Capacitor, electrolytic, 220 uf ±20%, 6V	Goodall	931-220-6-20
C7	Capacitor, electrolytic, 150 uf ±20%, 10V	Goodall	931-150-10-20
C8	Capacitor, electrolytic, 220 uf ±20%, 6V	Goodall	931-220-6-20
C9	Capacitor, electrolytic, 150 uf ±20%, 10V	Goodall	931-150-10-20
C10	Capacitor, electrolytic, 150 uf ±20%, 10V	Goodall	931-150-10-20
C11	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
CR1	Diode		1N914
CR2	Diode		1N914
CR3	Diode		1N273
CR4	Diode		1N273
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
Q4	Transistor		2N2924
Q5	Transistor		2N3250
R1	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R2	Resistor, fixed, composition, 10K ±10%, 1/4 watt		
R3	Resistor, fixed, composition, 120K ±10%, 1/4 watt		
R4	Resistor, fixed, composition, 22K ±10%, 1/4 watt		
R5	Resistor, fixed, composition, 1K ±10%, 1/4 watt		
R6	Resistor, fixed, composition, 470 ohms ±10%, 1/4 watt		
R7	Resistor, fixed, composition, 3.3K ±10%, 1/4 watt		
R8	Resistor, fixed, composition, 27K ±10%, 1/4 watt		
R9	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R10	Resistor, fixed, composition, 2.7K ±10%, 1/4 watt		
R11	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R12	Resistor, fixed, composition, 3.9K ±10%, 1/4 watt		
R13	Resistor, fixed, composition, 100 ohms ±10%, 1/4 watt		
R14	Resistor, fixed, composition, 2.2K ±10%, 1/4 watt		
R15	Resistor, fixed, composition, 2.7K ±10%, 1/4 watt		
R16	Resistor, fixed, composition, 560 ohms ±10%, 1/4 watt		
R17	Resistor, fixed, composition, 1K ±10%, 1/4 watt		

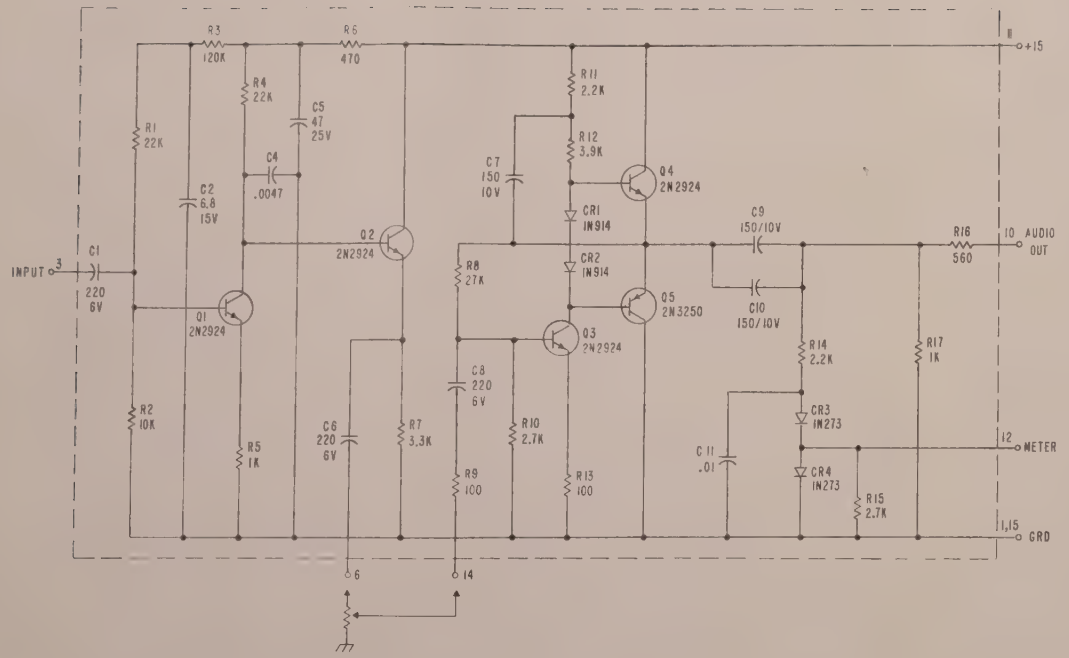


Figure 20-1. Schematic Diagram

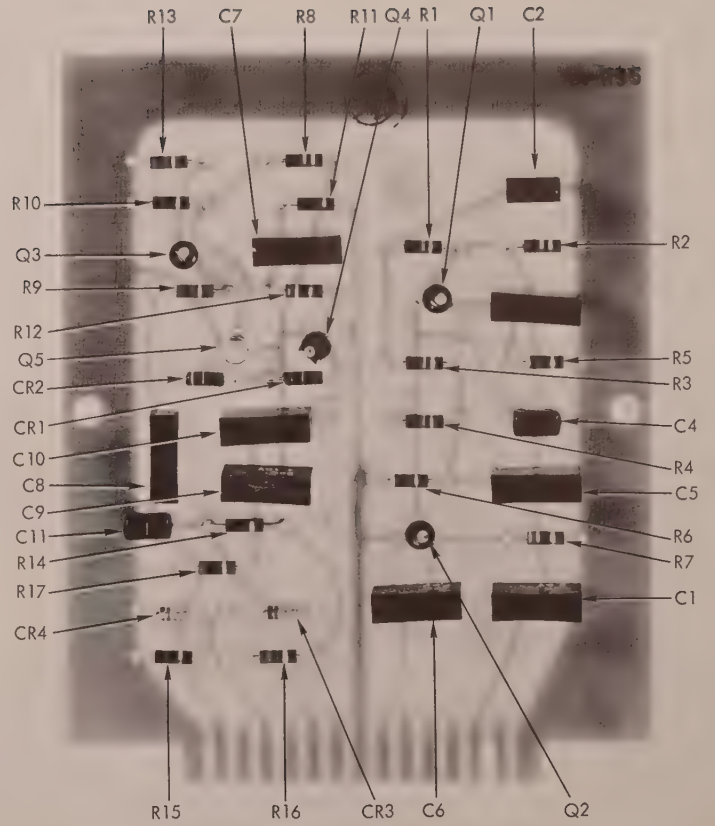


Figure 20-2. Parts Location View

20-1. CIRCUIT DESCRIPTION.

20-2. The audio circuit receives low frequency signals from the beat detector, an external source, or from the low frequency circuit. The amplified audio is supplied to the phones jack and to the beat meter.

20-3. Preamplifier Q1 and Q2 is a two-stage direct coupled amplifier designed for high gain. Capacitor C4 is used to filter out the high frequency component of the incoming signal.

20-4. Driver Q3 and complimentary amplifier Q4 and Q5 provide output amplification. Opposite types of transistors are used in the output amplifier to provide phase inversion and thus push-pull amplification. The amplifier is stabilized through feedback.

20-5. TEST EQUIPMENT.

20-6. Refer to Table 20-1 for a list of test equipment.

20-7. TEST.

20-8. Refer to paragraph 18-13 for a checkout procedure.

TABLE 20-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Signal Generator	5 cps to 10 KC	
	125 μv	
Oscilloscope	5 cps to 10 KC	
	5 volts peak-to-peak	

TABLE 20-2. TYPICAL DC VOLTAGES

CONDITIONS

a. Measured with VTVM.

b. Supply voltage of 15 ±0.1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	2.6	2	6.3
Q2	6.3	5.9	15
Q3	.7	.15	7
Q4	8.2	7.6	15
Q5	7	7.6	0

SECTION XXI

POWER SUPPLY MODULE
A17
(Figure 21-2)

REF DESIG	ITEM	MFR	PART NO.
A8	Rectifier Circuit Board (See figure 21-3)	Singer	AA-1185
A9	Power Supply Control Circuit (See figure 21-4)	Singer	AA-1184
A10	Oven and Nixie Control Circuit *See Section 22)	Singer	AA-1186
A11	1 MC Buffer Amplifier (See Section 25)	Singer	AA 1183
A12	1 MC Crystal Oscillator (See section 24)	Singer	AA 1182
A13	Video Amplifier (See Section 29)	Singer	AA-1181
A14	Mixer (See Section 28)	Singer	AA-1180
A15	8 MC Generator (See Section 27)	Singer	AA-1179
A16	Switch Assembly (See Section 23)	Singer	AA-1187
C1	Capacitor, electrolytic, 110 uf, 350V	GE	43F3013MA4
C2	Capacitor, electrolytic, 1150 uf, 50V	GE	43F3022MA4
C3	Capacitor, electrolytic, 1150 uf, 50V	GE	43F3022MA4
C4	Capacitor, electrolytic, 1150 uf, 50V	GE	43F3022MA4
C5	Capacitor, electrolytic, 1150 uf, 50V	GE	43F3022MA4
CR1	Diode, Zener, 200V		1N3015B
H1	Board Extractor	Singer	OM-1506
J1	Connector	Viking	2VH15/1AB8
J2	Connector	Viking	2VH15/1AB8
J3	Connector	Viking	2VH15/1AB8
J4	Connector	Viking	2VH15/1AB8
J5	Connector	Viking	2VH15/1AB8
J6	Connector	Viking	2VH15/1AB8
J7	Connector	Amphenol	MRE34PJ-0010
J8	Connector	Viking	2VH15/1AB8
J9	Connector	Viking	2VH15/1AB8
J11	Connector, with cable	Singer	WA-69
J12	Connector, with cable	Singer	WA-69
J13	Connector, with cable	Singer	WA-69
J14	Connector, with cable	Singer	WA-69
J15	Connector, with cable	Singer	WA-69
Q1	Transistor	RCA	2N1489
Q2	Transistor	RCA	2N1489
Q3	Transistor		2N1360
R1	Resistor, wirewound, 2K ±10%, 10W	Truohm	MOR10-2000
S1	Switch (altered from Muter Part No. 9604)	Singer	AA 1171
T1	Transformer	Singer	TP-20
T2	Transformer	Singer	TP-21
Y1	Crystal, 1 mc	Singer	YC-18
XY1	Socket	Cinch	51B16759

RECTIFIER CIRCUIT BOARD
A8
(Figure 21-3)

REF DESIG	ITEM	MFR	PART NO.
CR1	Rectifier Bridge	Diodes, Inc.	5199
CR2	Rectifier Bridge	Diodes, Inc.	5200
CR3	Rectifier Bridge	Diodes, Inc.	5199
CR4	Rectifier Bridge	Diodes, Inc.	5199
R1	Resistor, fixed, composition, 100K ±10%, 1W		

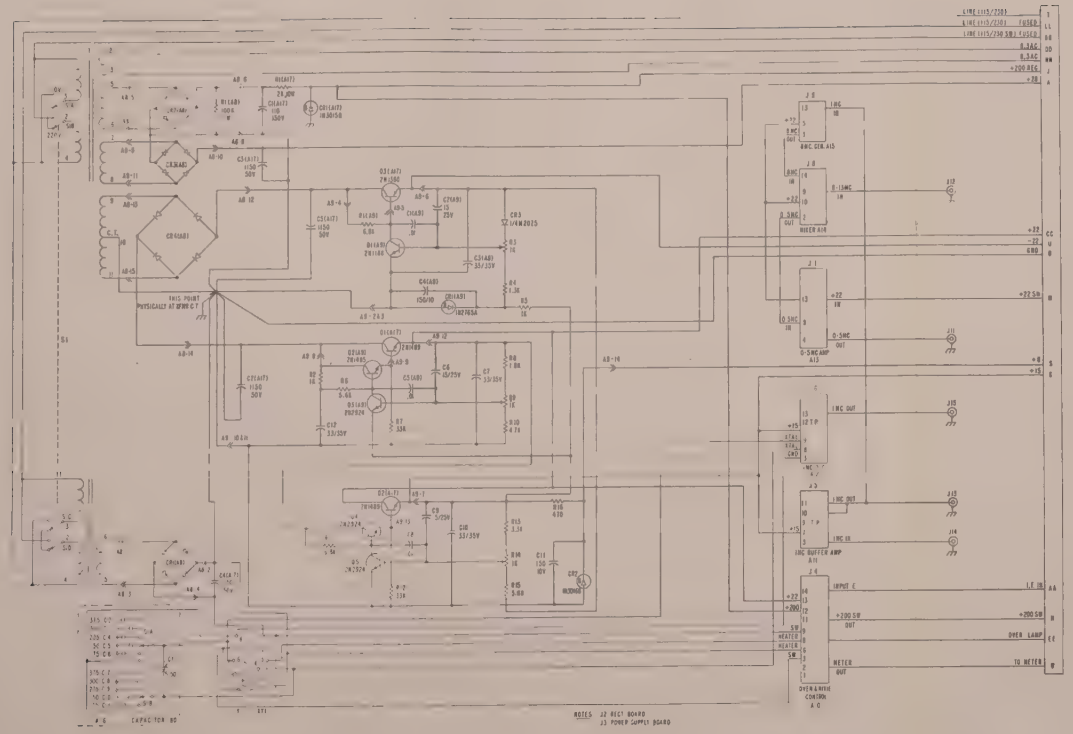


Figure 21-1. Schematic Diagram

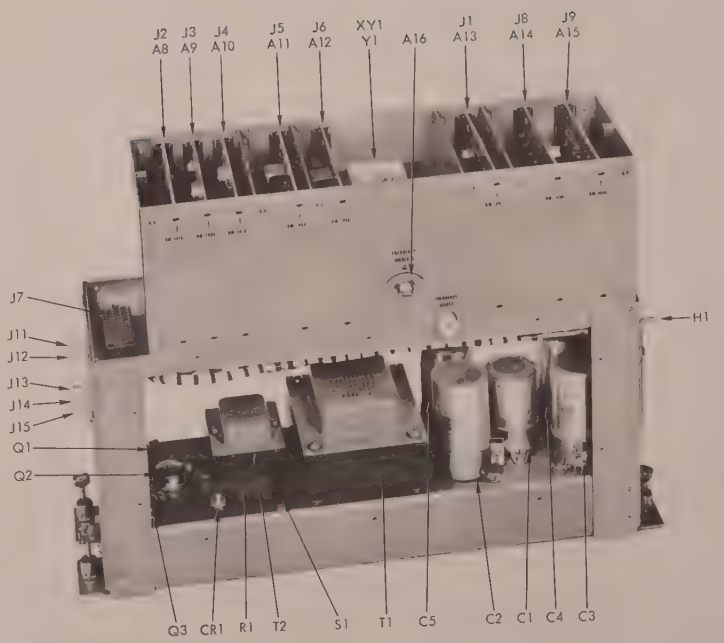


Figure 21-2. Parts Location

21-1. GENERAL.

21-2. This section covers the power supply components of the power supply module. For coverage of the additional components, refer to the following sections:

a. Crystal Oven and Nixie Control Circuits, see Section XXII.

b. 1 MC Circuits, see Sections XXIII, XXIV, and XXV.

c. 10 KC to 5 MC Circuits, see Sections XXVI, XXVII, and XXVIII.

21-3. CIRCUIT DESCRIPTION. (See figure 21-1.)

21-4. The power supply furnishes the following voltages:

a. 6.3 vac for the front panel indicator lights.

b. +28 vdc for operating the turret motor and the coaxial relays (see figure 21-5).

c. +22 vdc for the circuits shown in figure 21-6.

d. -22 vdc for the circuits shown in figure 21-7.

e. +6 vdc for the circuits shown in figure 21-8.

f. +15 vdc for the circuits shown in figure 21-9.

g. +200 vdc for the Nixie tubes (see Section XXII).

h. -24 vdc for the crystal oven (see Section XXII).

21-5. The 6.3 vac for the indicator lights is furnished by a separate secondary winding of transformer T1. The side of the line furnished to pin DD of connector J7 is referenced to ground externally.

21-6. The +200 vdc for the Nixie tubes is furnished by a separate secondary winding of transformer T1, rectified by diode bridge A8 CR2, filtered by resistors A8 R1 and A17 R1 and capacitor A17 C1, and regulated by Zener diode A17 CR1.

21-7. The +28 vdc for the turret motor and relays is furnished by a separate secondary winding of transformer T1, rectified by diode bridge A8 CR3, and filtered by capacitor A17 C3.

21-8. The -22, +6, +15, and +22 are all regulated voltages with interrelated regulation. The input to these supplies is furnished by a single secondary of transformer T1 and rectified by diode bridge A8 CR4.

21-9. The +6 vdc is regulated by Zener diode A9 CR2.

21-10. Transistor A17 Q2 is the series element for the +15 vdc supply. Transistor A9 Q5 provides dc error amplification and is referenced to ground. The error signal is applied to the series element through transistor A9 Q4. Resistor A9 R14 adjusts the output of the supply.

21-11. Transistor A17 Q1 is the series element for the +22 vdc supply. Transistor A9 Q3 provides dc error amplification and is referenced to regulated +15 vdc. The error signal is applied to the series element through transistor A9 Q2. Resistor A9 R9 adjusts the output of the supply.

21-12. Transistor A17 Q3 is the series element for the -22 vdc supply. Transistor A9 Q1 provides dc error amplification and is referenced to ground. Resistor A9 R3 adjusts the output of the supply.

21-13. The -24 vdc for the crystal oven is supplied by transformer T2, rectified by diode bridge A8 CR1, and filtered by capacitor A17 C4.

21-14. INPUT CIRCUIT. (See figure 21-10.) The ac input is filtered by line filter Z1 and fused by fuse F1. When 115/230 switch S1 is turned to the 115 position, the dual primaries of both transformers are placed in parallel. When the switch is turned to the 230 position, the dual primaries are placed in series.

21-15. TEST EQUIPMENT.

21-16. Refer to Table 21-1 for a list of test equipment.

21-17. CHECKOUT AND ADJUSTMENT.

21-18. To checkout and adjust the power supply, proceed as follows:

a. Measure ac voltage across pins DD and NN of connector J7.

b. Voltage shall be 6.3 vac ±10%.

c. Measure dc voltage from pin J of connector J7 to ground.

d. Voltage shall be +200 vdc ±10%.

e. Measure dc voltage from pin A of connector J7 to ground.

f. Voltage shall be +28 vdc ±10%.

g. Measure dc voltage from pin S of connector J7 to ground.

h. Voltage shall be 6.8 vdc ±0.3 vdc.

i. Measure dc voltage from pin U of connector J7 to ground.

j. Voltage shall be -22 vdc ±0.1 vdc. Readjust resistor A9 R3 as required to obtain output voltage within tolerance.

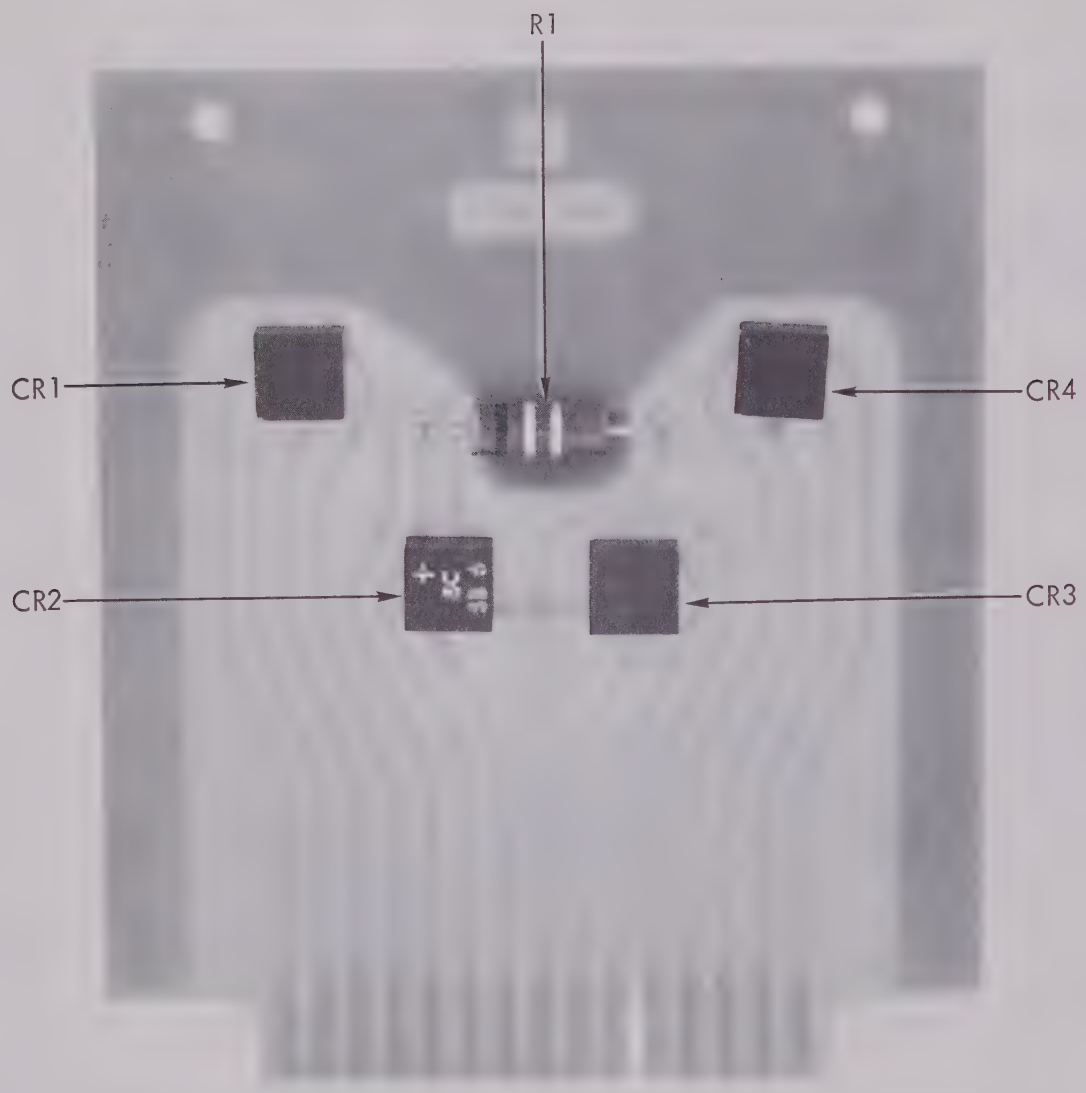


Figure 21-3. Parts Location

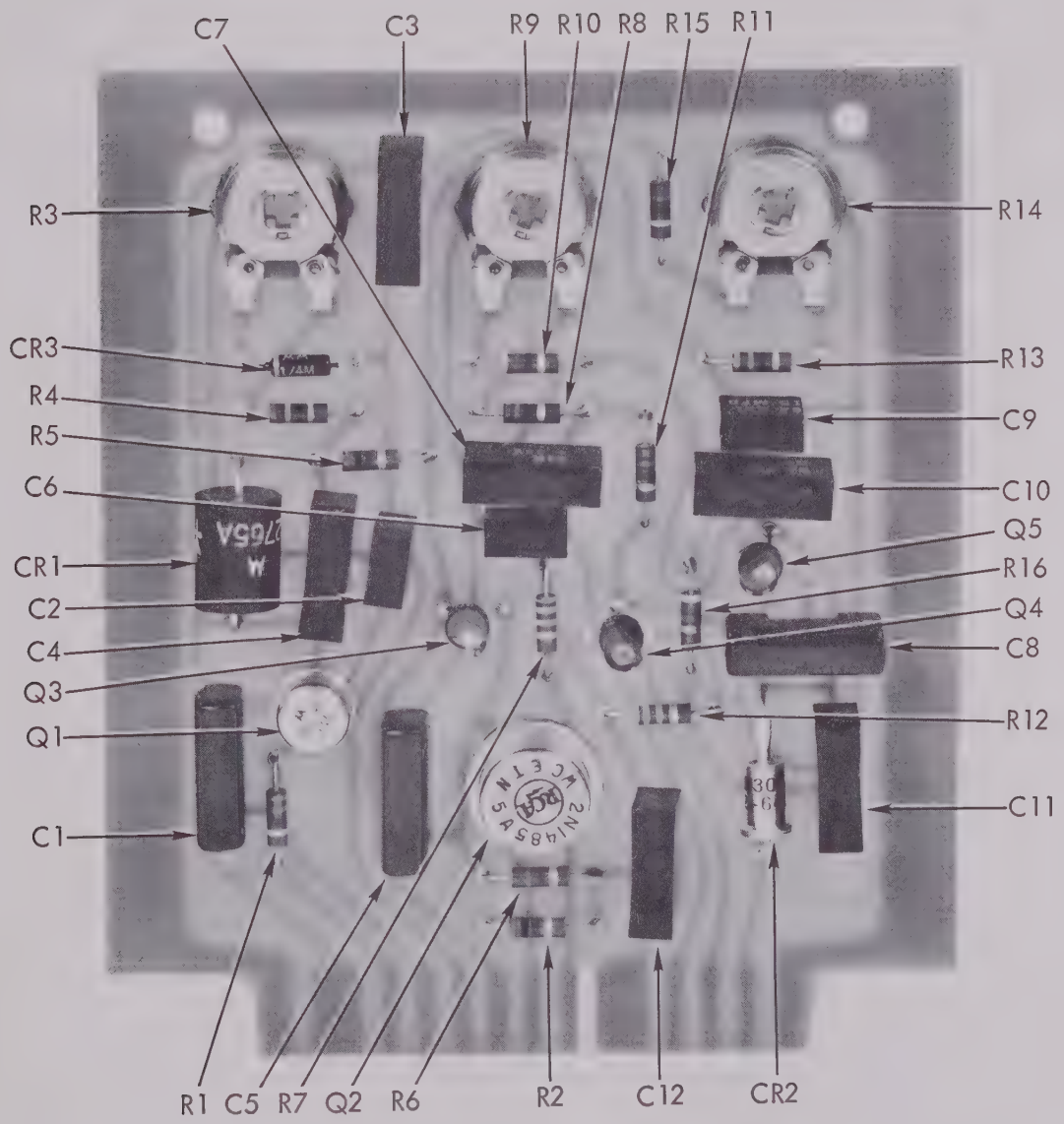


Figure 21-4. Parts Location

TABLE 21-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
VTVM	6 to 200 vdc	
	6.3 vac	

k. Measure dc voltage from pin K of connector J7 to ground.

l. Voltage shall be +15 vdc ±0.1 vdc. Readjust resistor A9 R14 as required to obtain output voltage within tolerance.

m. Measure dc voltage from pin CC of connector J7 to ground.

n. Voltage shall be +22 vdc ±0.1 vdc. Readjust resistor A9 R9 as required to obtain output voltage within tolerance.

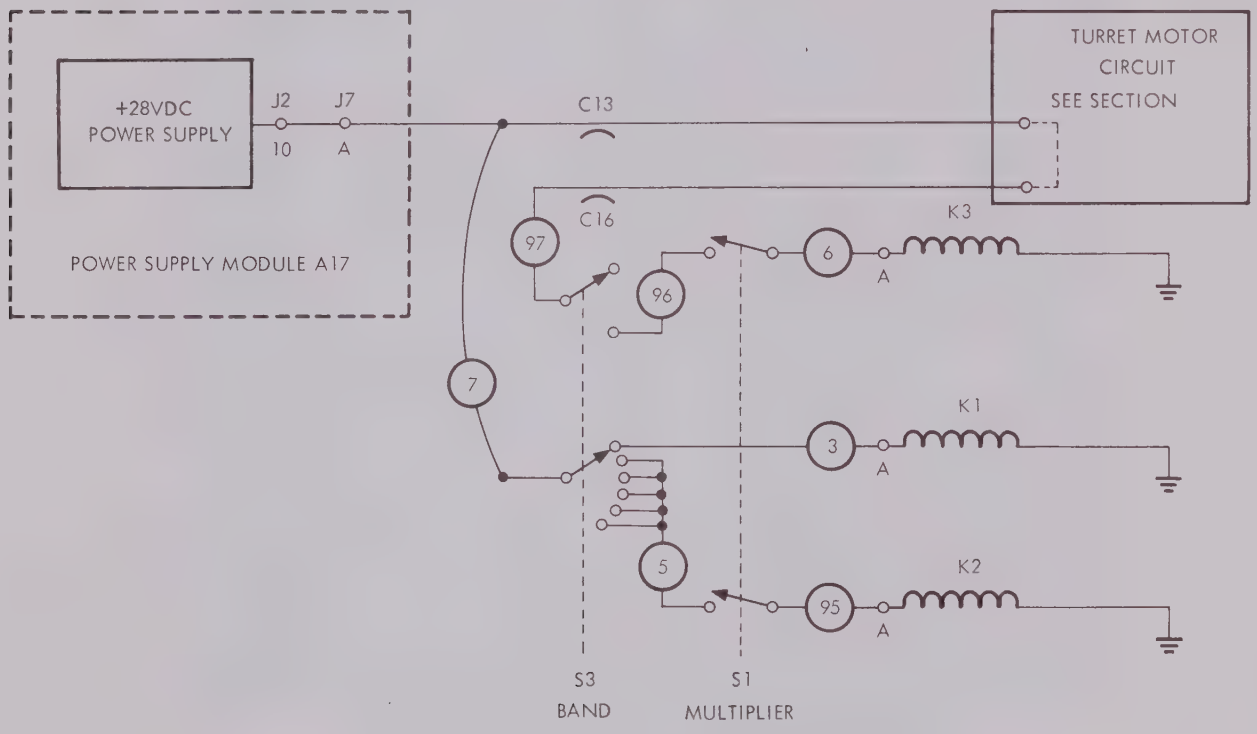


Figure 21-5. +28 VDC Distribution

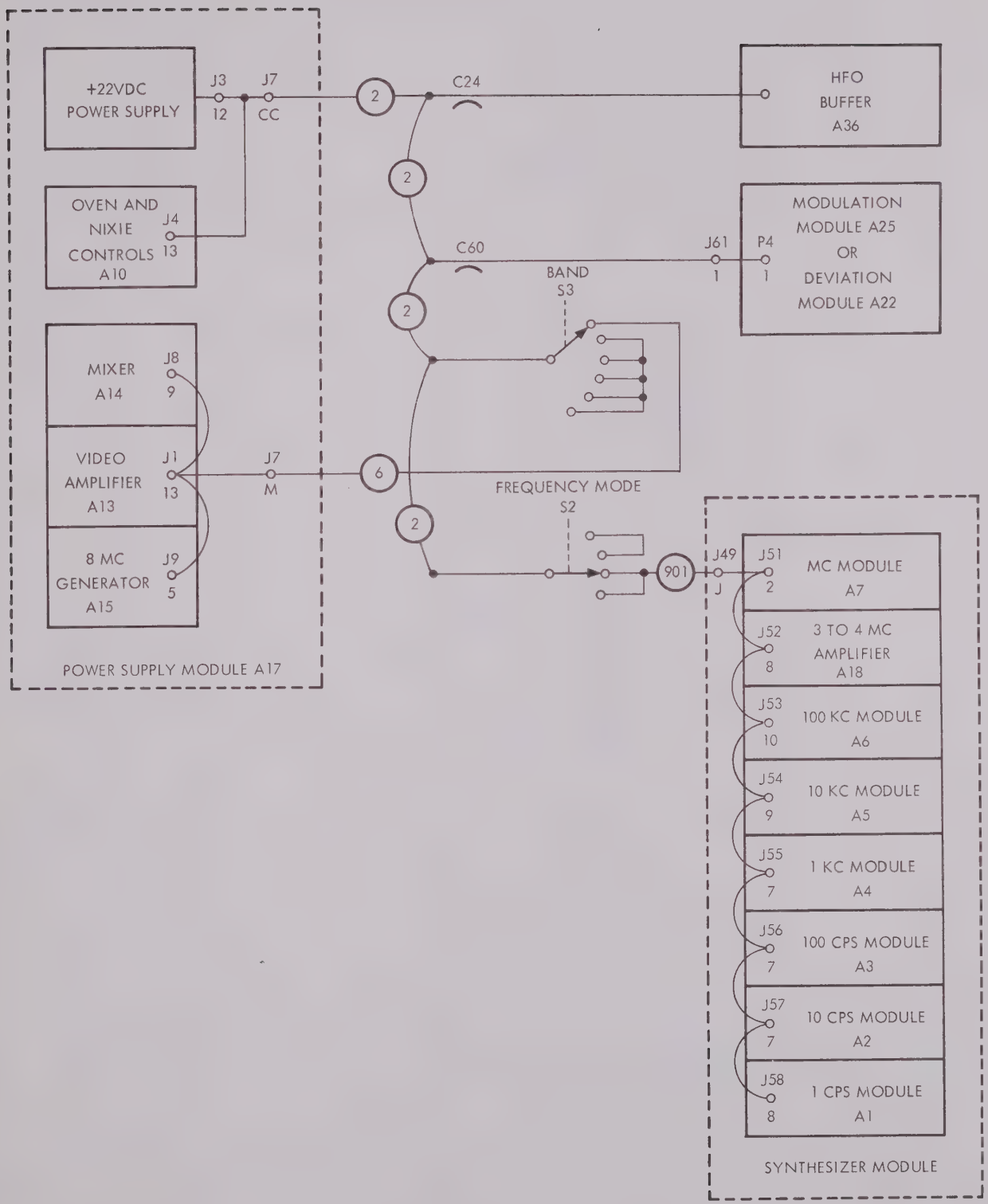


Figure 21-6. +22 VDC Distribution

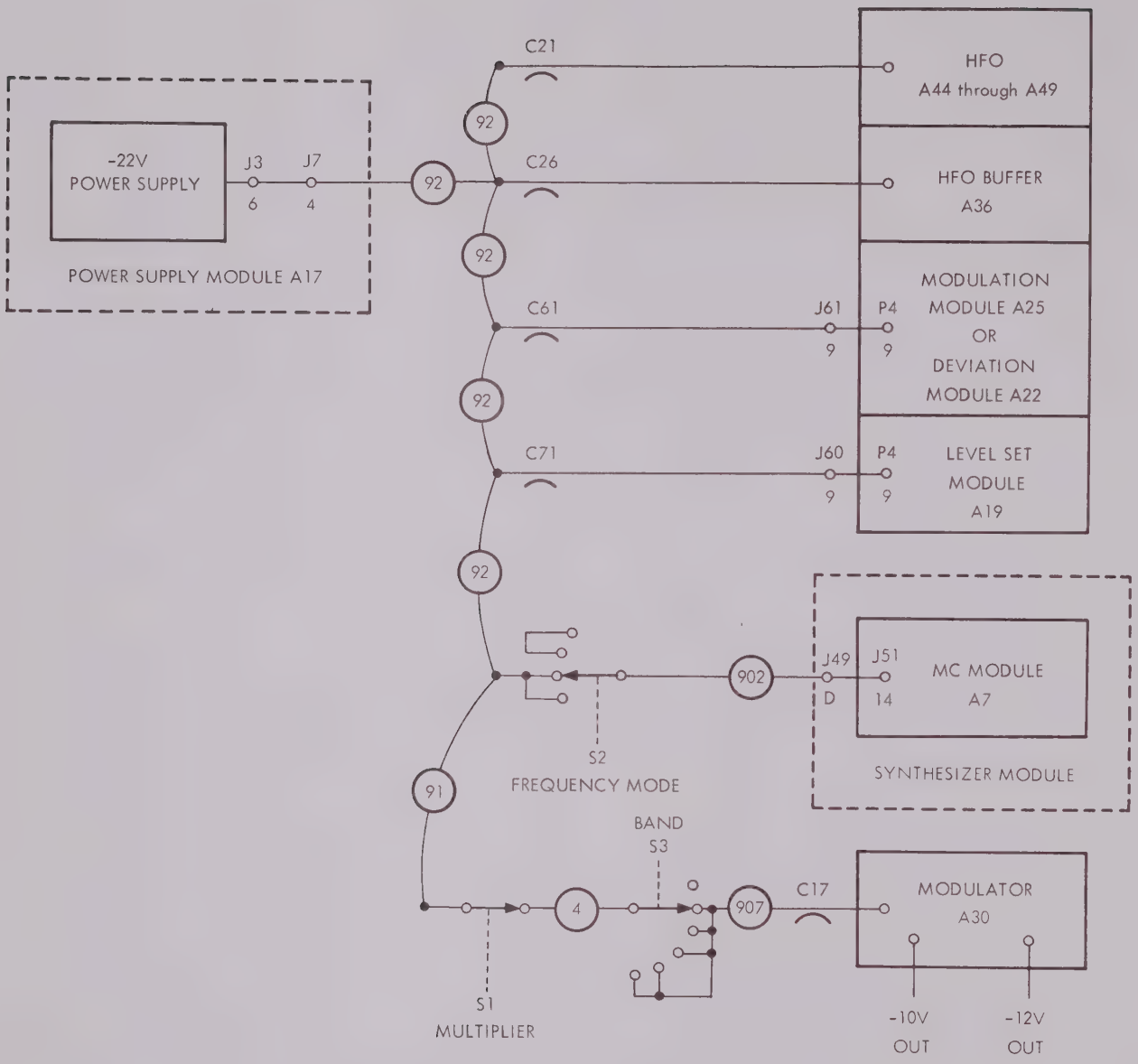


Figure 21-7. -22 VDC Distribution

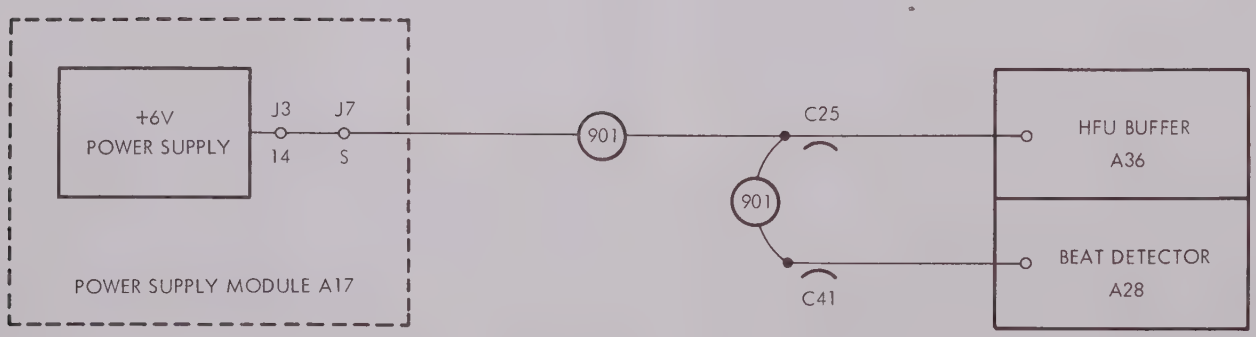


Figure 21-8. +6 VDC Distribution

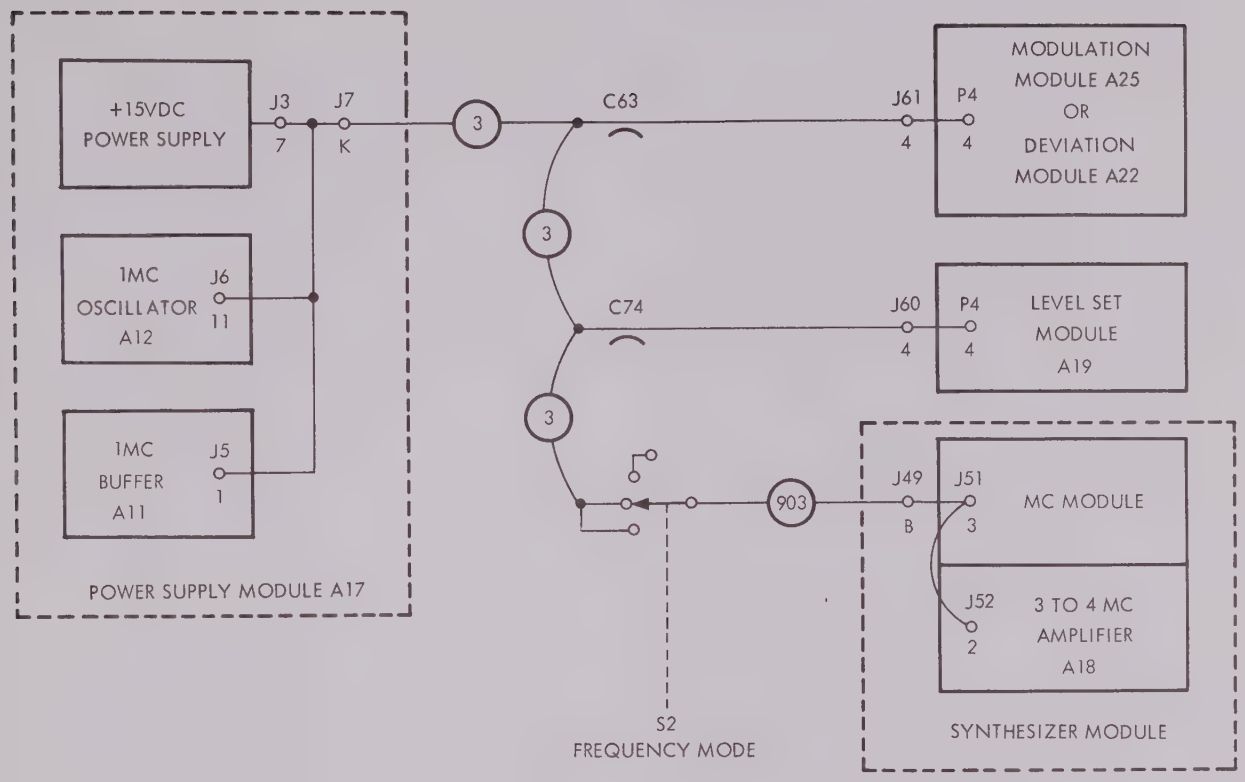


Figure 21-9. +15 VDC Distribution

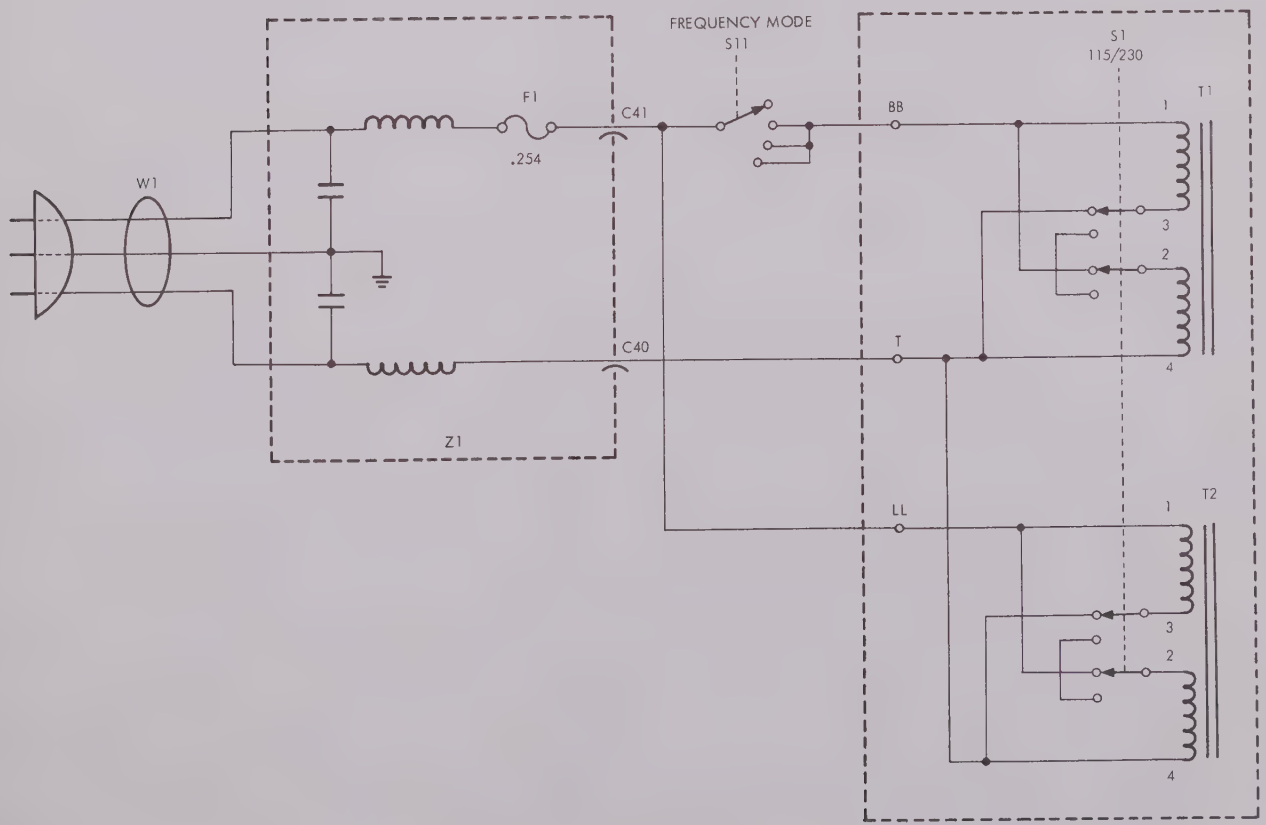


Figure 21-10. Power Input Circuit

POWER SUPPLY CONTROL CIRCUIT
A9
(Figure 21-4)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C2	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C3	Capacitor, electrolytic, 33 uf ±20%, 35V	Goodall	931-33-35-20
C4	Capacitor, electrolytic, 150 uf ±10%, 10V	Goodall	931-150-10-20
C5	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C6	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C7	Capacitor, electrolytic, 33 uf ±20%, 35V	Goodall	931-33-35-20
C8	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C9	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C10	Capacitor, electrolytic, 33 uf ±20%, 35V	Goodall	931-33-35-20
C11	Capacitor, electrolytic, 150 uf ±20%, 10V	Goodall	931-150-10-20
CR1	Diode, zener, 15V	Motorola	1N2765A
CR2	Diode, zener, 6V	Motorola	1N3016B
CR3	Diode	Motorola	1/4M20Z5
Q1	Transistor		2N1188
Q2	Transistor		2N1485
Q3	Transistor		2N2924
Q4	Transistor		2N2924
Q5	Transistor		2N2924
R1	Resistor, fixed, composition, 68K ±10%, 1/4W		
R2	Resistor, fixed, composition, 1K ±10%, 1/4W		
R3	Resistor, variable, 1K	Mallory	MTC-4-1K
R4	Resistor, fixed, composition, 1.3K ±10%, 1/4W		
R5	Resistor, fixed, composition, 1K ±10%, 1/4W		
R6	Resistor, fixed, composition, 5.6K ±10%, 1/4W		
R7	Resistor, fixed, composition, 33K ±10%, 1/4W		
R8	Resistor, fixed, composition, 1.8K ±10%, 1/4W		
R9	Resistor, variable, 1K	Mallory	MTC-4-1K
R10	Resistor, fixed, composition, 4.7K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R11	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R12	Resistor, fixed, composition, 33K ±10%, 1/4W		
R13	Resistor, fixed, composition, 3.3K ±10%, 1/4W		
R14	Resistor, variable, 1K	Mallory	MTC-4-1K
R15	Resistor, fixed, composition, 5.6K ±10%, 1/4W		
R16	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		

SECTION XXII

CRYSTAL OVEN AND NIXIE CONTROL CIRCUIT
A10

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, electrolytic, 6.8 uf ±20%, 35V	Goodall	931-6.8-35-20
C2	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
CR1	Diode	Semtech	SC2
K1	Relay, Reed	Dunco	MRR1A
Q1	Transistor		2N1485
Q2	Transistor		2N2924
Q3	Transistor		2N2924
R1	Resistor, fixed, composition, 3.3K ±10%, 1/4W		
R2	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		
R3	Resistor, variable, 50K	Mallory	MTC-4-50K
R4	Resistor, fixed, composition, 22K ±10%, 1/4W		
R5	Resistor, variable, 1K	Mallory	MTC-4-1K
R6	Resistor, fixed, composition, 2.2K ±10%, 1/4W		

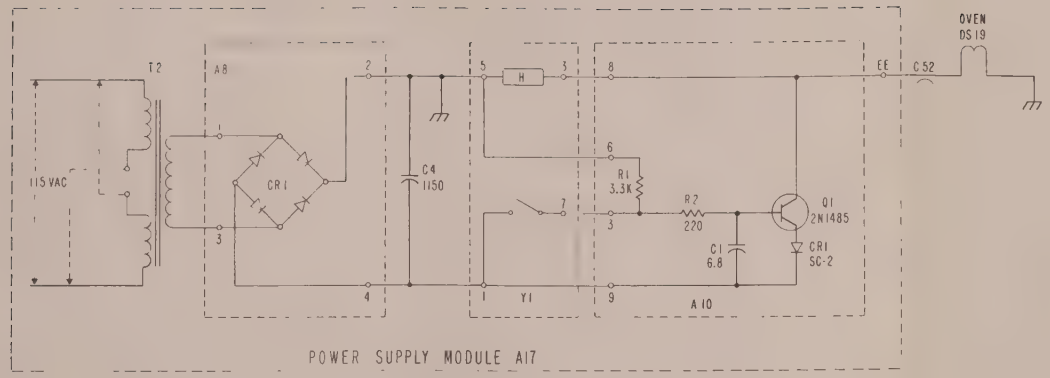


Figure 22-1. Schematic Diagram

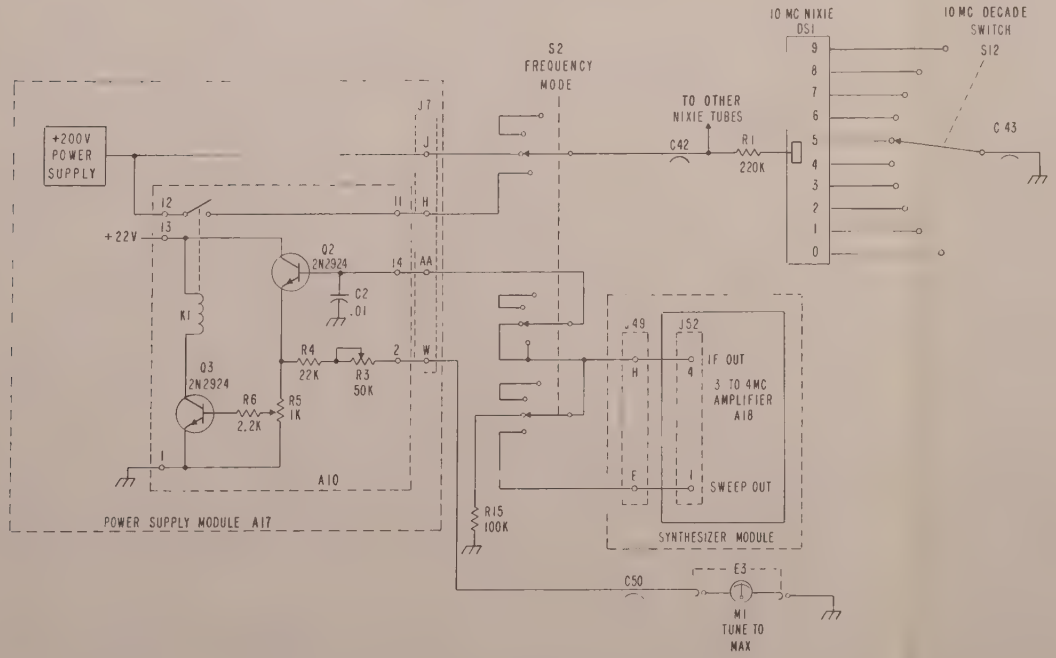


Figure 22-2. Schematic Diagram

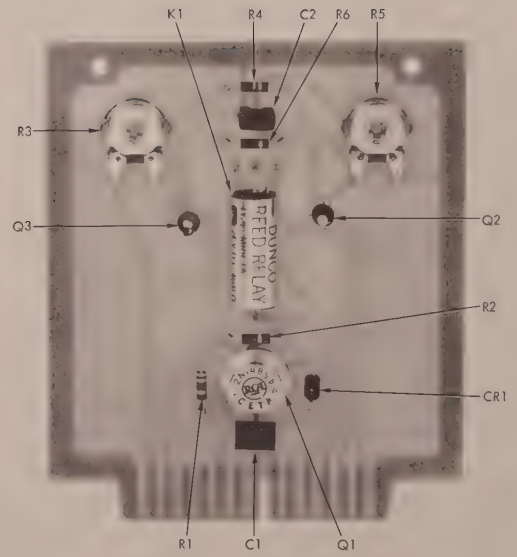


Figure 22-3. Parts Location

22-1. GENERAL.

22-2. The crystal oven and Nixie control circuit performs two separate functions: (1) to control power to the heater of the crystal oven and (2) to control the 200 vdc power to the Nixie tubes.

22-3. CRYSTAL OVEN CONTROL CIRCUIT. (See figure 22-1.) Transistor Q1 is controlled by the thermostat and in turn controls power to the oven heater. When temperature within the crystal oven drops below the allowable temperature, the thermostat closes and transistor Q1 conducts. Power is then furnished to the heater and OVEN light DS19.

22-4. NIXIE CONTROL CIRCUIT. (See figure 22-2.) When the FREQUENCY MODE switch is turned to the LOCK position, the synthesizer furnishes two signals to the Nixie control circuit. The two signals are combined and applied to the TUNE TO MAX meter and to relay K1. Relay K1, in turn, controls the +200 vdc supply to the Nixie tubes.

22-5. When the HFO is locked to the control frequency, the IF output of the 3 to 4 MC amplifier is maximum and there is no sweep output voltage. Under these conditions, transistor Q3 will draw sufficient current to operate K1 and the Nixie tubes will glow steadily. Meter M2 indicates the IF level. Lock can only occur when the HFO is tuned to approximately the control frequency.

22-6. If the HFO frequency is close to the control frequency but no lock has occurred, the sweep output voltage opposes the IF output and is a half cycle voltage. Under these conditions, relay K1 operates on a half cycle basis and the Nixie tubes will flash on and off.

22-7. If the HFO frequency is outside the lock range, the IF output is too low to operate the relay and the Nixie tubes remain off.

22-8. Resistor R5 adjusts the operate point of relay K1. Resistor R3 calibrates the TUNE TO MAX relay.

22-9. TEST EQUIPMENT.

22-10. Refer to Table 22-1 for a list of test equipment.

22-11. CRYSTAL OVEN CONTROL CHECKOUT.

22-12. To checkout the crystal oven control circuit, proceed as follows (perform checkout with ambient temperature of 65° to 75°F):

a. Remove crystal Y1 from socket (see figure 21-2). Allow crystal to stabilize at room temperature for at least 1/2 hour.

b. Replace crystal Y1 in socket.

c. Check that oven indicator lights.

d. Check that oven indicator remains lit for no more than 15 minutes and then begins to cycle on and off.

22-13. NIXIE CONTROL ADJUSTMENTS.

22-14. To adjust the Nixie control circuit, proceed as follows:

a. Turn FREQUENCY MODE switch to the FREE position.

b. Connect dc power supply to pin AA of connector J7. Set dc output to +2V.

c. Connect VTVM to pin H of connector J7.

d. Adjust resistor as required until 200 vdc is indicated at pin H (relay operated).

e. Adjust dc power supply and check that relay operates at 2 vdc.

f. Adjust resistor R3 as required to set the TUNE TO MAX meter to approximately half scale.

TABLE 22-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
VTVM	+2 to 200 vdc	
Power Supply	+2 vdc output	

SECTION XXIII

CAPACITOR ASSEMBLY
A16
(Figure 23-3)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, variable, 5 to 50 pf	JFD	VC55C
C2	Capacitor, mica, 375 pf ±1%	Elmenco	DM15E3750F
C3	Capacitor, mica, 300 pf ±1%	Elmenco	DM15E301F
C4	Capacitor, mica, 225 pf ±1%	Elmenco	DM15E2250F
C5	Capacitor, mica, 150 pf ±1%	Elmenco	DM15E151F
C6	Capacitor, mica, 75 pf ±1%	Elmenco	DM15E750F
C7	Capacitor, mica, 375 pf ±1%	Elmenco	DM15E3750F
C8	Capacitor, mica, 300 pf ±1%	Elmenco	DM15E301F
C9	Capacitor, mica, 225 pf ±1%	Elmenco	DM15E2250F
C10	Capacitor, mica, 150 pf ±1%	Elmenco	DM15E151F
C11	Capacitor, mica, 75 pf ±1%	Elmenco	DM15E750F
S1	Switch, rotary	Singer	SW-320

IMC DISTRIBUTION BOX
A29
(Figure 23-4)

REF DESIG	ITEM	MFR	PART NO.
J16	Connector, coax	Microdot	31-49
J17	Connector, coax	Microdot	31-49
J18	Connector, coax	Microdot	31-49
J19	Connector, coax	Microdot	31-49
J20	Connector, coax	Microdot	31-49
J25	Connector, BNC		UG-604/U
J26	Connector		UG-604/U
R1	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
S1	Switch	Microswitch	6AT6

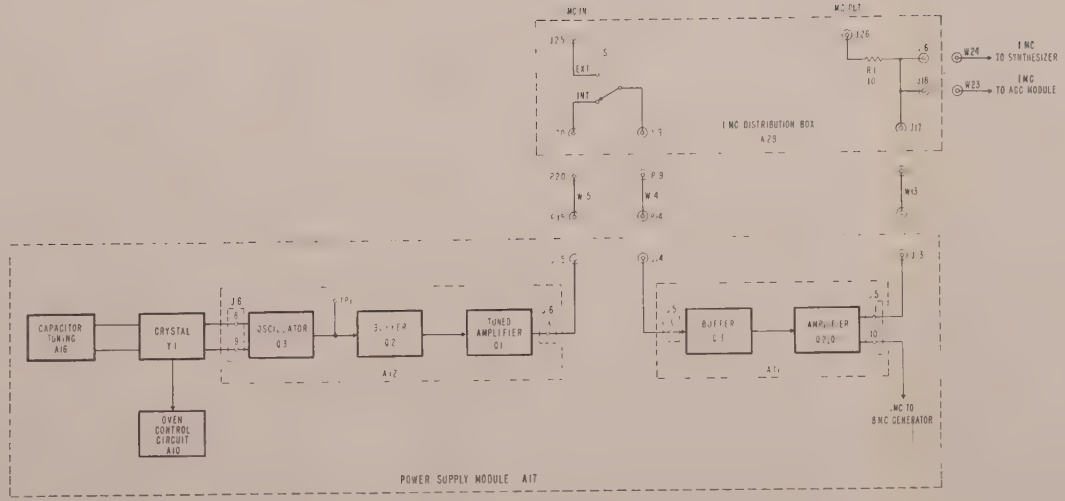


Figure 23-1. Schematic Diagram

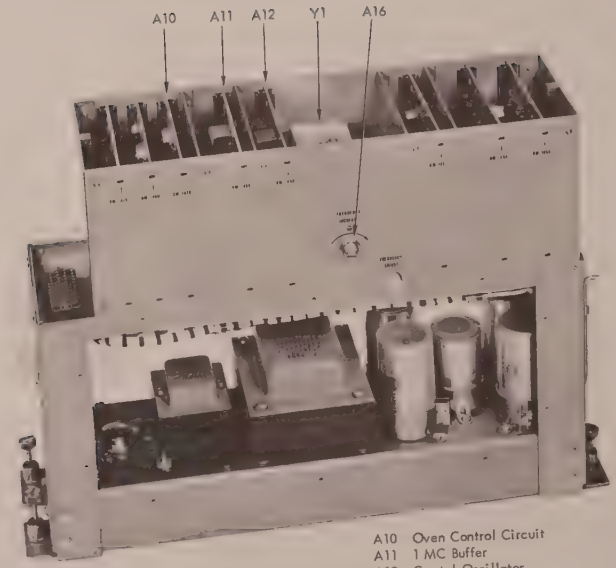


Figure 23-2. Parts Location

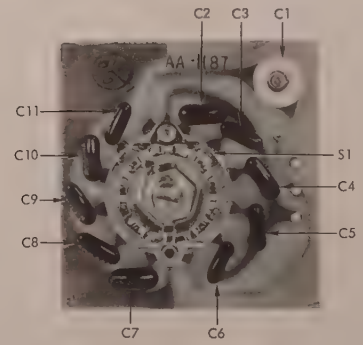


Figure 23-3. Parts Location

23-1. GENERAL.

23-2. This section contains general information covering the 1 MC circuits. For detail information on the various individual circuits, refer to the following sections:

a. 1 MC Oscillator A12, see Section XXIV.

b. 1 MC Buffer A11, see Section XXV.

c. Oven Control Circuit A10, see Section XXII.

23-3. CIRCUIT DESCRIPTION.

23-4. The 1 MC drive for the control frequency can be supplied from the internal crystal oscillator circuit A12 or from an external source. The drive is selected by the EXT-INT switch S1 of the 1 MC distribution box A29 (see figure 23-4). The selected 1 MC drive is amplified (and/or limited) in buffer circuit A11 and then distributed to the 8 MC generator, the synthesizer, and the level set module. A 1 MC output signal is supplied for checking the crystal.

23-5. Capacitor tuning assembly A16 (see figure 23-3) includes fixed and a variable capacitor which may be selected to set the crystal frequency. The oven control circuit, in conjunction with the thermostat in the crystal, maintains the crystal at a constant temperature.

23-6. TEST EQUIPMENT.

23-7. Refer to Table 23-1 for a list of test equipment.

23-8. CHECKOUT.

23-9. To checkout the 1 MC circuit, proceed as follows:

a. Connect oscilloscope to the 1MC OUT jack J26.

b. Connect 1 MC source to the 1MC IN jack J25. Set source to produce 1 vrms output.

c. Turn EXT-INT switch S1 to EXT.

d. Check that output signal is 1 MC ±10 cps with an output of 3V peak-to-peak or more.

e. Increase output of 1 MC source to 2 vrms.

f. Check that output signal is 1 MC ±10 cps with an output of 3V peak-to-peak. Any troubles are probably in the 1 MC buffer A11.

g. Turn EXT-INT switch S1 to INT.

h. Check that the output signal level is 3V peak-to-peak or more.

i. Connect counter to 1MC OUT jack J26.

j. The output signal shall be 1 MC ±1 cps.

NOTE

See Section II for the 1 MC calibration procedure.

k. If any problems are encountered, the trouble is probably in the 1 MC circuit.

TABLE 23-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
1 MC Source	1 MC ±10 cps	
	.1 to 2 vrms output	
Oscilloscope	1 MC frequency	
Counter	1 MC	

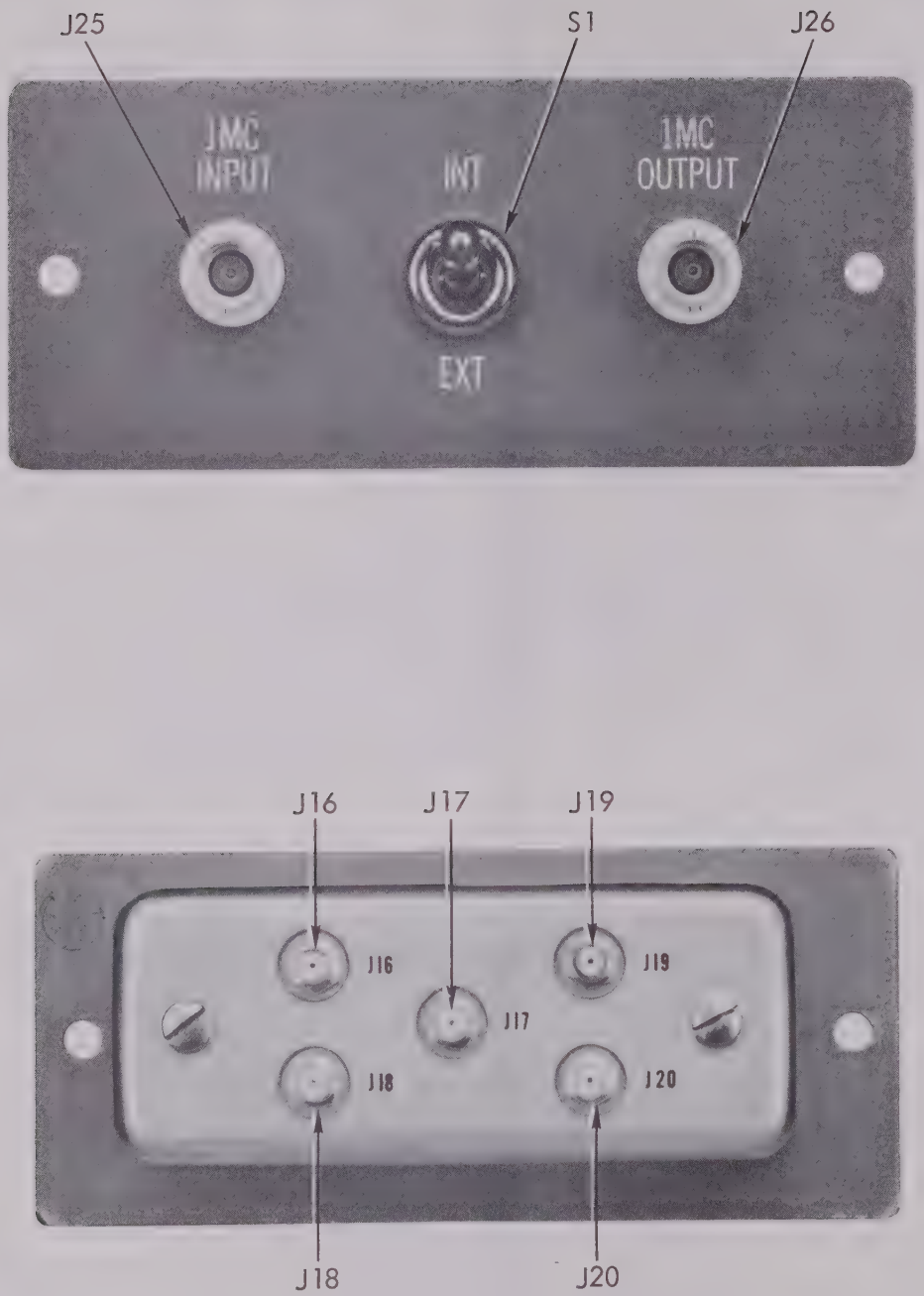


Figure 23-4. Parts Location

SECTION XXIV

IMC CRYSTAL OSCILLATOR
A12

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C2	Capacitor, mica, 620 pf ±5%	Elmenco	DM15E621J
C3	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C4	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C5	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C6	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C7	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C8	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C9	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C10	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C11	Capacitor, mica, 500 pf ±1%	Elmenco	DM15E501F
C12	Capacitor, mica, 500 pf ±1%	Elmenco	DM15E501F
C13	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
C14	Capacitor, mica, 330 pf ±1%	Elmenco	DM15E331F
C15	Capacitor, mica, 330 pf ±1%	Elmenco	DM15E331F
C16	Capacitor, mica, 330 pf ±1%	Elmenco	DM15E331F
C17	Capacitor, mica, 330 pf ±1%	Elmenco	DM15E331F
CR1	Diode		1N914
CR2	Diode		1N914
L1	Coil	Singer	LR-23
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
R1	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 10K ±10%, 1/4W		
R3	Resistor, fixed, composition, 68K ±10%, 1/4W		
R4	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R5	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R6	Resistor, fixed, composition, 100K ±10%, 1/4W		
R7	Resistor, fixed, composition, 100K ±10%, 1/4W		

REF DESIG	ITEM	MFR	PART NO.
R8	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R9	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R10	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R11	Resistor, fixed, composition, 220K ±10%, 1/4W		
R12	Resistor, fixed, composition, 100K ±10%, 1/4W		

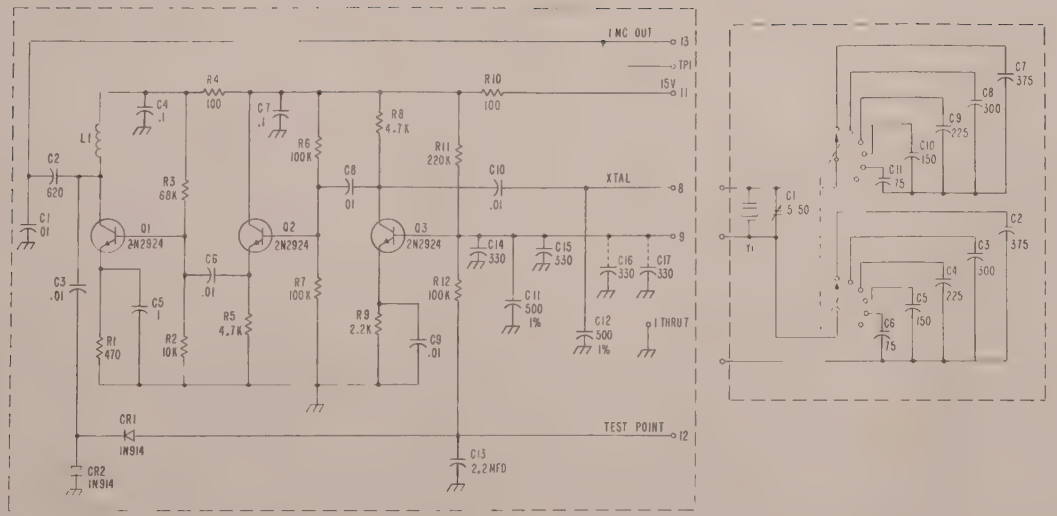


Figure 24-1. Schematic Diagram

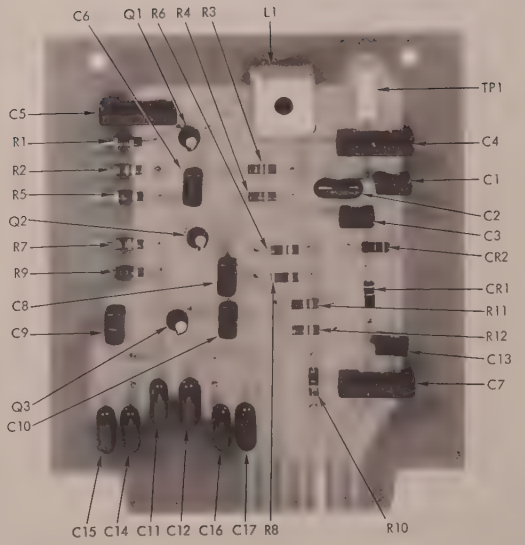


Figure 24-2. Parts Location

24-1. CIRCUIT DESCRIPTION.

24-2. The oscillator Q3 is a modified colpitts circuit designed for stable performance regardless of supply voltage changes. The oscillator is isolated from the lead by buffer Q2 and amplifier Q1.

24-3. Amplifier Q1 supplies an AGC voltage to the oscillator through diodes CR1 and CR2. The amplifier is tuned by coil L1.

24-4. TEST EQUIPMENT.

24-5. Refer to Table 24-1 for a list of test equipment.

24-6. CHECKOUT.

24-7. To checkout the 1 MC oscillator, proceed as follows:

a. Connect oscilloscope to test point TP1.

b. The output shall be 0.8 ±.1 volt peak-to-peak.

c. Connect counter to test point TP1.

d. The output shall be 1 MC ±0.1 cps.

TABLE 24-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	1 MC, .5 to 10V peak-to-peak	
VTVM	.1 to 15 vdc	
Counter	1 MC, 0.8 ±.1V peak-to-peak input	

TABLE 24-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Supply voltage of +15 vdc ±.1 vdc.

b. Measured with VTVM.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	+1.6	+.98	+14
Q2	+6.9	+6.2	+14.6
Q3	+.62	+.11	+14.2

TABLE 24-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	R10	VTVM	+15 ±1 vdc	
2. Q1 Output	Collector Q1	Scope	7.4V peak-to-peak	
3. AGC Voltage	C13	VTVM	-5.8 vdc	

SECTION XXV

IMC BUFFER
A11

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mica, 2200 pf ±5%	Elmenco	DM19E222J
C2	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C3	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C4	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C5	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C6	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
C7	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
C8	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C9	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C10	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
CR1	Diode		1N914
CR2	Diode		1N914
CR3	Diode		1N914
CR4	Diode		1N914
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
R1	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R3	Resistor, fixed, composition, 10K ±10%, 1/4W		
R4	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R5	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R6	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R7	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R8	Resistor, fixed, composition, 1 meg ±10%, 1/4W		
R9	Resistor, fixed, composition, 220K ±10%, 1/4W		
R10	Resistor, fixed, composition, 1K ±10%, 1/4W		
R11	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
T1	Transformer	Singer	LR-24

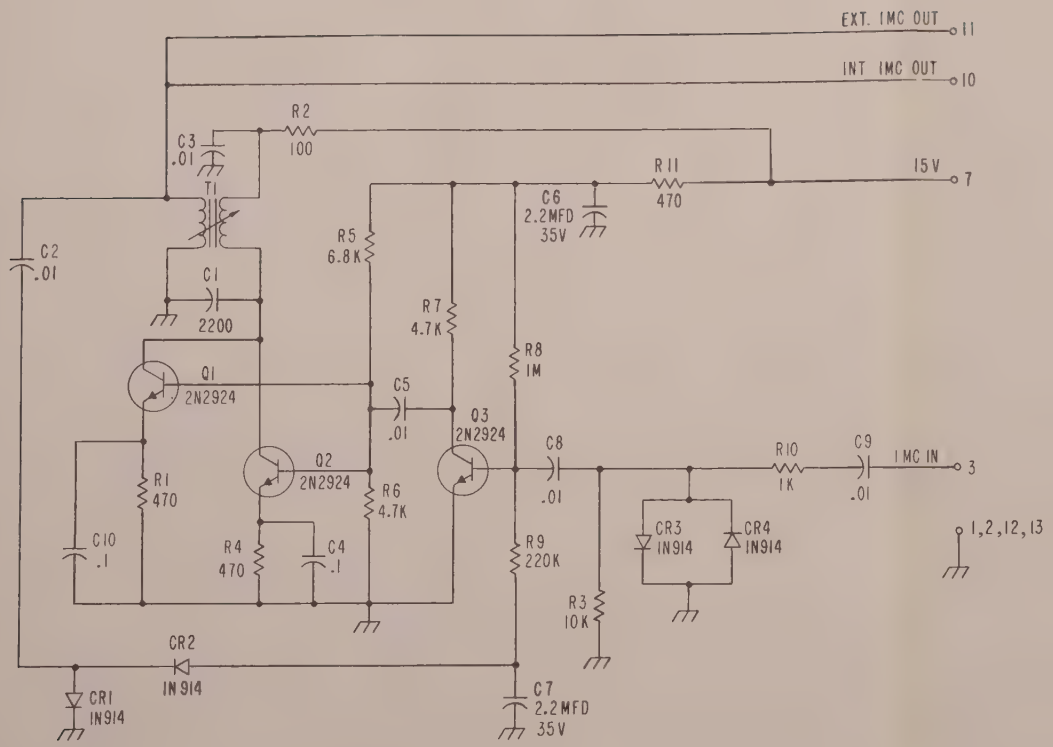


Figure 25-1. Schematic Diagram

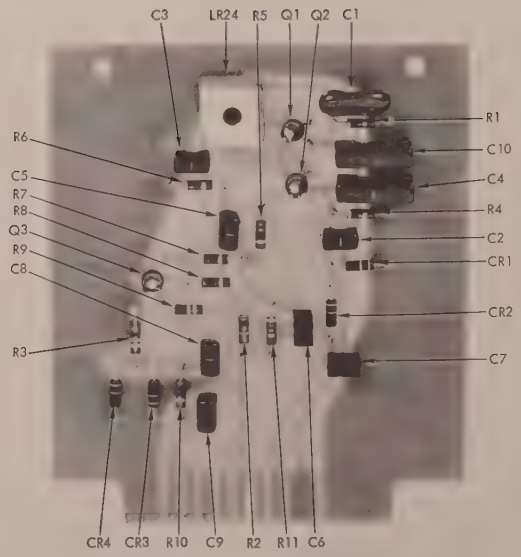


Figure 25-2. Parts Location

25-1. CIRCUIT DESCRIPTION.

25-2. The 1 MC buffer receives a 1 MC signal from the crystal oscillator and delivers a fixed-amplitude, sine wave output. The circuit operates as both a limiter and an amplifier with AGC.

25-3. Diodes CR3 and CR4 limit the input signal to a maximum of .4 volt peak-to-peak. The signal is amplified by amplifier Q3 and parallel amplifies Q1 and Q2. The output signal is supplied by transformer T1 which ensures a sine wave output. Diodes CR1 and CR2 provide the AGC voltage.

25-4. TEST EQUIPMENT.

25-5. Refer to Table 25-1 for a list of test equipment.

25-6. ADJUSTMENT.

25-7. To adjust the 1 MC buffer, proceed as follows:

a. Connect oscilloscope to output (C2 or pin 10 or 11).

b. Turn EXT-INT switch to INT.

c. Adjust transformer T1 as required to obtain an output with a 3V peak-to-peak.

TABLE 25-4. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	1 MC, .1 to 5V peak-to-peak	
VTVM	.1 to 15 vdc	

TABLE 25-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. 15 ±1 vdc supply voltage.

b. Measured with VTVM.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	+.46	0	+12.5
Q2	+5.6	+5.1	+12.5
Q3	+5.6	+5.1	+12.5

TABLE 25-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	R11	VTVM	+15 ±1 vdc	
2. Limiter	R9	Scope	.4V peak-to-peak	With .46V peak-to-peak input.
3. Q3 Output	Collector Q3	Scope	.6V peak-to-peak	
4. Q1, Q2 Output	C1	Scope	7.5V peak-to-peak	
5. AGC Output	C7	VTVM	-1.8V	With .46V peak.

SECTION XXVI

10 KC to 5 MC CIRCUITS

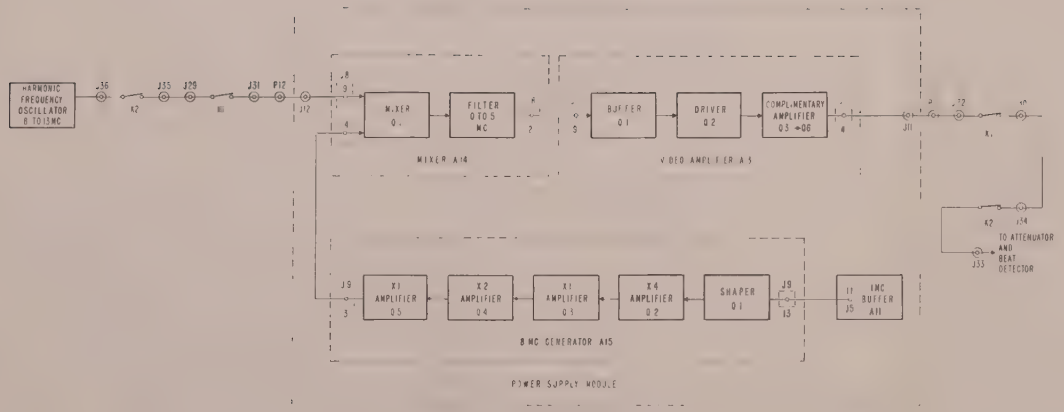
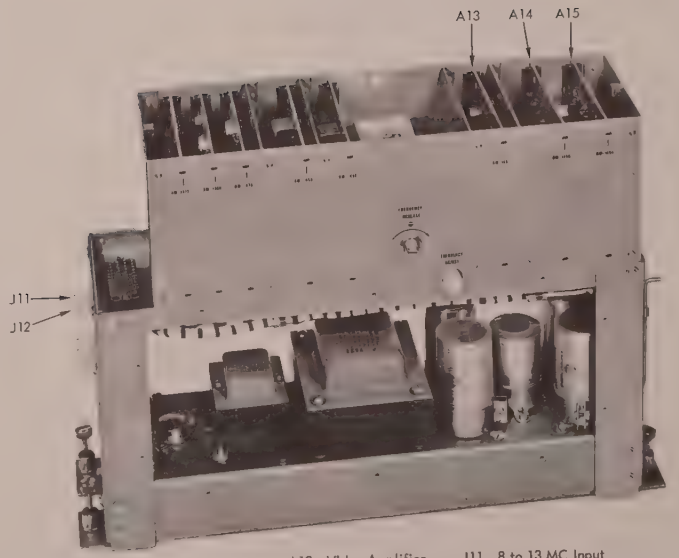


Figure 26-1. Schematic Diagram



A13 Video Amplifier
A14 Mixer
A15 8MC Generator
J11 8 to 13 MC Input
J12 10 KC to 5 MC Output

Figure 26-2. Parts Location

26-1. GENERAL.

26-2. This section contains general information covering the 10 KC to 5 MC circuits. For detail information on the various individual circuits, refer to the following sections:

a. 8 MC Generator A15, see Section XXVII.

b. Mixer A14, see Section XXVIII.

c. Video Amplifier A13, see Section XXIX.

26-3. CIRCUIT DESCRIPTION.

26-4. An 8 to 13 MC signal from the high frequency oscillator is mixed with a fixed 8 MC signal. The mixer produces a difference signal in the 10 KC to 5 MC range which is filtered, amplified, and applied to the output circuits.

26-5. The fixed 8 MC signal is derived from the 1 MC crystal through a multiplication process. The 1 MC signal is first applied to a shaper stage which produces 1 MC spikes, rich in harmonics. The X4 multiplier is an amplifier stage tuned to the fourth harmonic. The X2 multiplier is similar.

26-6. The output of the mixer is filtered to alternate harmonics and amplified to provide an output signal with the same amplitude as the 8 to 13 MC input.

26-7. TEST EQUIPMENT.

26-8. Refer to Table 26-1 for a list of test equipment.

26-9. CHECKOUT.

26-10. To checkout the 10 KC to 5 MC circuits, proceed as follows:

a. Connect horizontal input of oscilloscope to the 1 MC input (pin 13 of J9).

b. Connect vertical input of oscilloscope to the 8 MC output of the 8 MC generator (pin 3 of J9).

c. Using Lissajous patterns, check that the output of the 8 MC generator is 8 MC. Any troubles are in the 8 MC generator A15.

d. Connect vertical input of oscilloscope to the HFO buffer input (J12 or pin 9 of J8).

e. Set up the Model SSG-1 to produce 1 MC output.

f. Using Lissajous patterns, check that the input from the HFO buffer is 9 MC. Any troubles are in the HFO circuit or relays K1 and K2.

g. Connect vertical input of oscilloscope to the mixer output (pin 2 of J8).

h. Using Lissajous patterns, check that the mixer output is 1 MC. Any troubles are in mixer A14.

i. Connect vertical input of oscilloscope to the video amplifier output (pin 4 of J1).

j. Using Lissajous patterns, check that the amplifier output is 1 MC. Any troubles are in video amplifier A13.

TABLE 26-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	1 to 10 MC	

SECTION XXVII

8MC GENERATOR
A15

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
C2	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C3	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C4	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C5	Capacitor, mica, 120 pf ±10%	Elmenco	DM15E121J
C6	Capacitor, mica, 2200 pf ±10%	Elmenco	DM19E222J
C7	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C8	Capacitor, mica, 150 pf ±10%	Elmenco	DM15E151J
C9	Capacitor, mica, 1000 pf ±10%	Elmenco	DM15E102J
C10	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C11	Capacitor, mica, 680 pf ±10%	Elmenco	DM15E681J
C12	Capacitor, mica, 33 pf ±10%	Elmenco	DM15E330J
C13	Capacitor, mica, 390 pf ±10%	Elmenco	DM15E391J
C14	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
C15	Capacitor, mica, 33 pf ±10%	Elmenco	DM15E330J
C16	Capacitor, mica, 200 pf ±10%	Elmenco	DM15E201J
C17	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
C18	Capacitor, electrolytic, 2.2 uf ±20%, 35V	Goodall	931-2.2-35-20
L1	Coil, adjustable	Singer	LR-21
L2	Coil, adjustable	Singer	LR-21
L3	Coil, adjustable	Singer	LR-21
L4	Coil, adjustable	Singer	LR-21
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N2924
Q4	Transistor		2N2924
Q5	Transistor		2N2924
R1	Resistor, fixed, composition, 180 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R3	Resistor, fixed, composition, 47K ±10%, 1/4W		
R4	Resistor, fixed, composition, 10K ±10%, 1/4W		
R5	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R6	Resistor, fixed, composition, 33K ±10%, 1/4W		
R7	Resistor, fixed, composition, 5.6K ±10%, 1/4W		
R8	Resistor, fixed, composition, 1K ±10%, 1/4W		
R9	Resistor, fixed, composition, 33K ±10%, 1/4W		
R10	Resistor, fixed, composition, 5.6K ±10%, 1/4W		
R11	Resistor, fixed, composition, 1K ±10%, 1/4W		
R12	Resistor, fixed, composition, 220 ohms ±10%, 1/4W		
R13	Resistor, fixed, composition, 33K ±10%, 1/4W		
R14	Resistor, fixed, composition, 10K ±10%, 1/4W		
R15	Resistor, fixed, composition, 1K ±10%, 1/4W		
R16	Resistor, fixed, composition, 33K ±10%, 1/4W		
R17	Resistor, fixed, composition, 10K ±10%, 1/4W		
R18	Resistor, fixed, composition, 1K ±10%, 1/4W		
R19	Resistor, fixed, composition, 1K ±10%, 1/4W		
R20	Resistor, fixed, composition, 1K ±10%, 1/4W		
R21	Resistor, fixed, composition, 1K ±10%, 1/4W		
R22	Resistor, fixed, composition, 1K ±10%, 1/4W		
R23	Resistor, fixed, composition, 27 ohms ±10%, 1/4W		

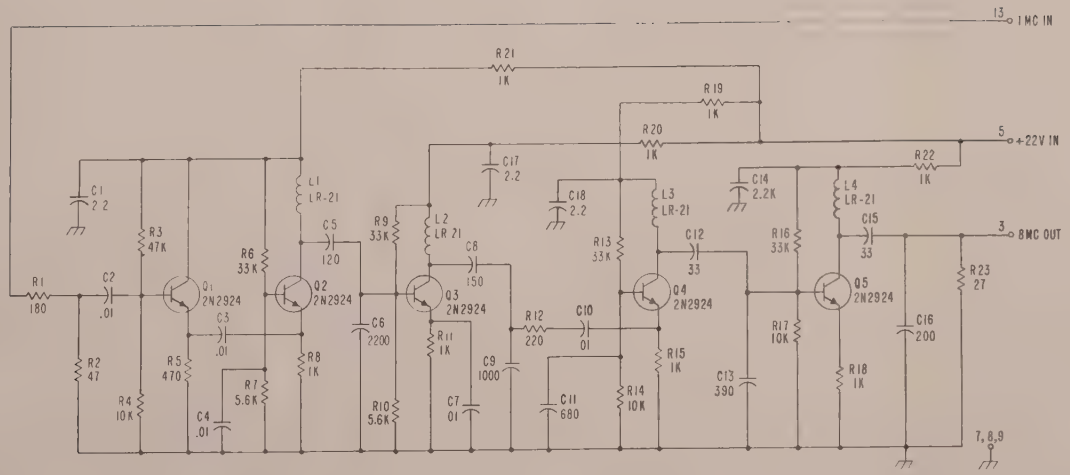


Figure 27-1. Schematic Diagram

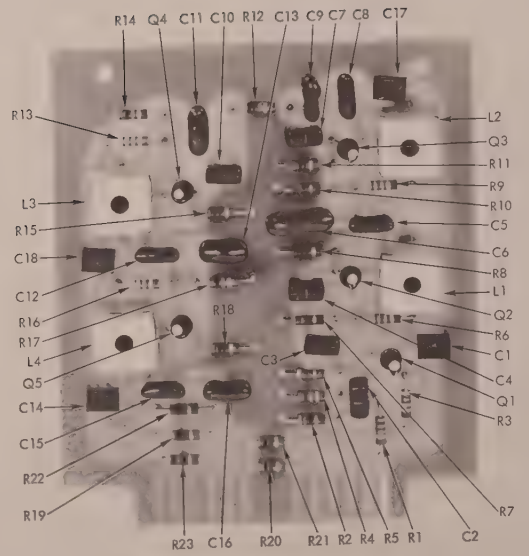


Figure 27-2. Parts Location

27-1. CIRCUIT DESCRIPTION.

27-2. The 8 MC generator receives a 1 MC signal from the crystal circuits and delivers an 8 MC signal to the mixer A14. Shaper Q1 converts the input sine wave to a modified spike which is rich in harmonics. Amplifier Q2 is tuned to the fourth harmonic (4 MC) by coil L1. Amplifier Q3 amplifies the output and is tuned by coil L2. Amplifier Q4 is tuned to the second harmonic (8 MC) by coil L3. Amplifier Q5 amplifies the 8 MC signal and is tuned by coil L4.

27-3. TEST EQUIPMENT.

27-4. Refer to Table 27-1 for a list of test equipment.

27-5. ADJUSTMENT.

27-6. To adjust the circuit, proceed as follows:

a. Connect scope to base of Q3.

b. Adjust coil L1 for a 4 MC output.

c. Connect scope to the output of Q3 (junction of C8 and C9).

d. Adjust coil L2 for a 4 MC output.

e. Connect scope to the base of Q5.

f. Adjust coil L3 for an 8 MC output.

g. Connect scope to the 8 MC output (pin 3 of J9).

h. Adjust coil L4 for an 8 MC output.

TABLE 27-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	1 to 8 MC, .2 to 5V peak-to-peak	
VTVM	.1 to 22 vdc	

TABLE 27-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Supply voltage of +22 vdc ±0.1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	2.5	2.0	15.0
Q2	2.2	1.8	15.0
Q3	2.7	2.2	19.0
Q4	3.9	3.7	17.5
Q5	4.0	3.5	18.0

TABLE 27-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	Pin 5	VTVM	22.0 ±0.1 vdc	
2. Input Signal	Pin 13	Scope	1 MC, 3.0V peak-to-peak	
3. Output of Q1	C3	Scope	.4V peak-to-peak half-wave	

TABLE 27-3. DYNAMIC MEASUREMENTS (CONT)

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
4. Output of Q2	Junction C5 and C6	Scope	.38V , 4 MC	
5. Output of Q3	Junction C8 and C9	Scope	3.4V , 4 MC	
6. Output of Q4	Junction C12 and C13	Scope	2V , 8 MC	
7. Output of Q5	Pin 3	Scope	.95V peak-to-peak, sine wave, 8 MC	

SECTION XXVIII

MIXER
A14

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, electrolytic, 6.8 uf ±20%, 35V	Goodall	931-6.8-35-20
C2	Capacitor, electrolytic, 6.8 uf ±20%, 35V	Goodall	931-6.8-35-20
C3	Capacitor, electrolytic, 6.8 uf ±20%, 35V	Goodall	931-6.8-35-20
C4	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C5	Capacitor, electrolytic, 15uf ±20%, 25V	Goodall	931-15-25-20
C6	Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
C7	Capacitor, mica, 82 pf ±5%	Elmenco	DM15E820J
C8	Capacitor, mica, 82 pf ±5%	Elmenco	DM15E820J
C9	Capacitor, mica, 82 pf ±5%	Elmenco	DM15E820J
C10	Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
L1	Inductor, 15 uh	Miller	70F155A1
L2	Inductor, 22 uh	Miller	70F225A1
L3	Inductor, 27 uh	Miller	70F275A1
L4	Inductor, 27 uh	Miller	70F275A1
L5	Inductor, 22 uh	Miller	70F225A1
L6	Inductor, 15 uh	Miller	70F155A1
Q1	Transistor		2N1742
R1	Resistor, fixed, composition, 27 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 10K ±10%, 1/4W		
R3	Resistor, fixed, composition, 6.8K ±10%, 1/4W		
R4	Resistor, variable, 50K	Mallory	MTC-4-50K
R5	Resistor, wirewound, 576 ohms ±1%, 1/8W		
R6	Resistor, fixed, composition, 1K ±10%, 1/4W		
R7	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R8	Resistor, wirewound, 576 ohms ±1%, 1/8W		
R9	Resistor, variable, 100 ohms	Mallory	MTC-4-100
R10	Not used		
R11	Not used		
R12	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		
R13	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		

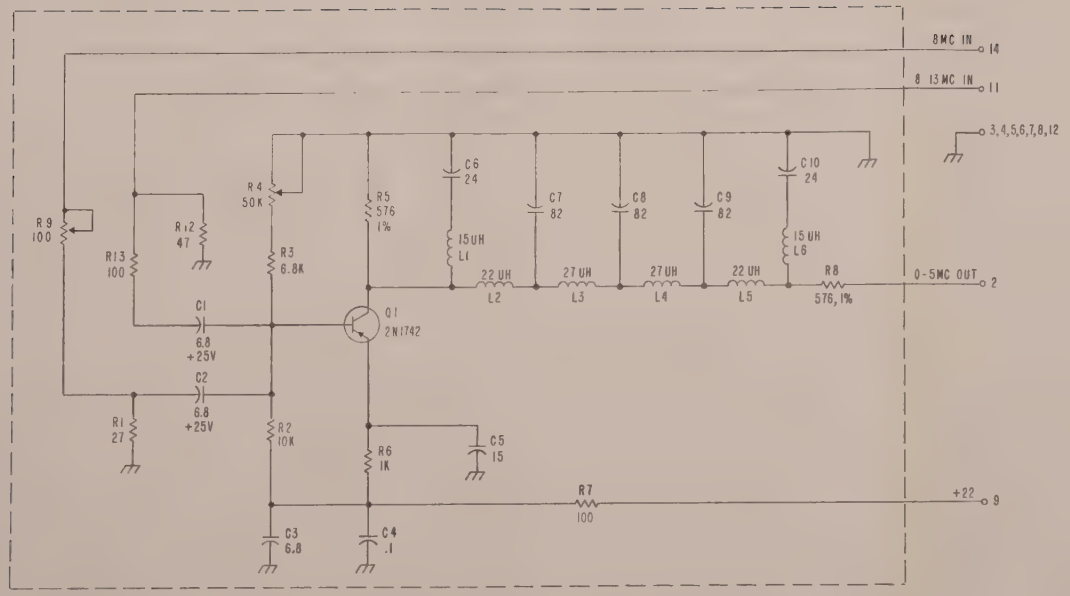


Figure 28-1. Schematic Diagram

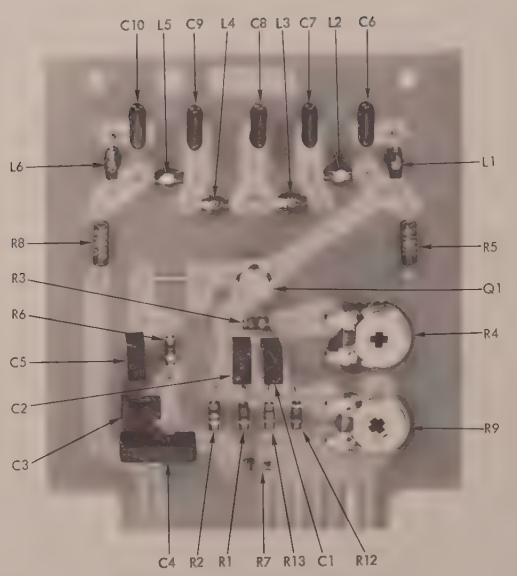


Figure 28-2. Parts Location

28-1. CIRCUIT DESCRIPTION.

28-2. The mixer receives an 8 MC signal from the 8 MC generator A15 and an 8 to 13 MC signal from the high frequency oscillator. The mixer delivers a 10 KC to 5 MC signal to the video amplifier A13.

28-3. Resistor R9 balances the two input signals and resistor R4 adjusts the bias on mixer Q1. The output is filtered to eliminate harmonics and any high frequency components.

28-4. TEST EQUIPMENT.

28-5. Refer to Table 28-1 for a list of test equipment.

28-6. ADJUSTMENT.

28-7. To adjust the mixer, proceed as follows:

a. Set up the Model SSG-1 to produce a 4.01 output signal.

b. Connect scope to the output (pin 2 of J8).

c. Adjust R4 to provide an output of .15V peak-to-peak.

d. Adjust R9 as required to minimize modulation of the output.

e. Since the two controls interact, repeat steps c and d for the best compromise position.

TABLE 28-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	1 to 10 MC, .1 to 5V peak-to-peak	
VTVM	.1 to 22 vdc	
Circuit Board Extender (Singer Part No. 1867)		

TABLE 28-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Supply voltage of 22 ±0.1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	17	17.2	2.5

TABLE 28-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	R7	VTVM	22 ±0.1 vdc	
2. Fixed Input	Pin 14	Scope	8 MC, 1V peak-to-peak ±10%	
3. Variable Input	Pin 11	Scope	.56V peak-to-peak, 8 to 13 MC	Frequency determined by setting of SSG-1.
4. Mixer Output	Collector of Q1	Scope	4V peak-to-peak, 10 KC to 5 MC	Frequency determined by setting of SSG-1.
5. Filter Output	Pin 2	Scope	.15V peak-to-peak, 10 KC to 5 MC	Frequency determined by setting of SSG-1.

SECTION XXIX

VIDEO AMPLIFIER
A13

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C2	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C3	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C4	Capacitor, mylar, 0.1 uf ±10%, 50V	Paktron	MR700-.1
C5	Capacitor, mylar, 0.047 uf	West-Cap	MW64K2473
C6	Capacitor, variable, 2 to 8 pf	Erie	538-006NP02-8
C7	Not used		
C8	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C9	Capacitor, electrolytic, 15 uf ±20%, 25V	Goodall	931-15-25-20
C10	Capacitor, mica, 620 pf ±10%	Elmenco	DM15E621J
CR1	Diode		1N914
CR2	Diode		1N914
Q1	Transistor		2N2924
Q2	Transistor		2N2924
Q3	Transistor		2N3137
Q4	Transistor		2N1495
Q5	Transistor		2N3137
Q6	Transistor		2N3137
R1	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R2	Resistor, fixed, composition, 2.2K ±10%, 1/4W		
R3	Resistor, fixed, composition, 1K ±10%, 1/4W		
R4	Resistor, fixed, composition, 3.3K ±10%, 1/4W		
R5	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R6	Resistor, fixed, composition, 1K ±10%, 1/4W		
R7	Resistor, fixed, composition, 1K ±10%, 1/4W		
R8	Resistor, fixed, composition, 330 ohms ±10%, 1/4W		
R9	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R10	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R11	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R12	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		

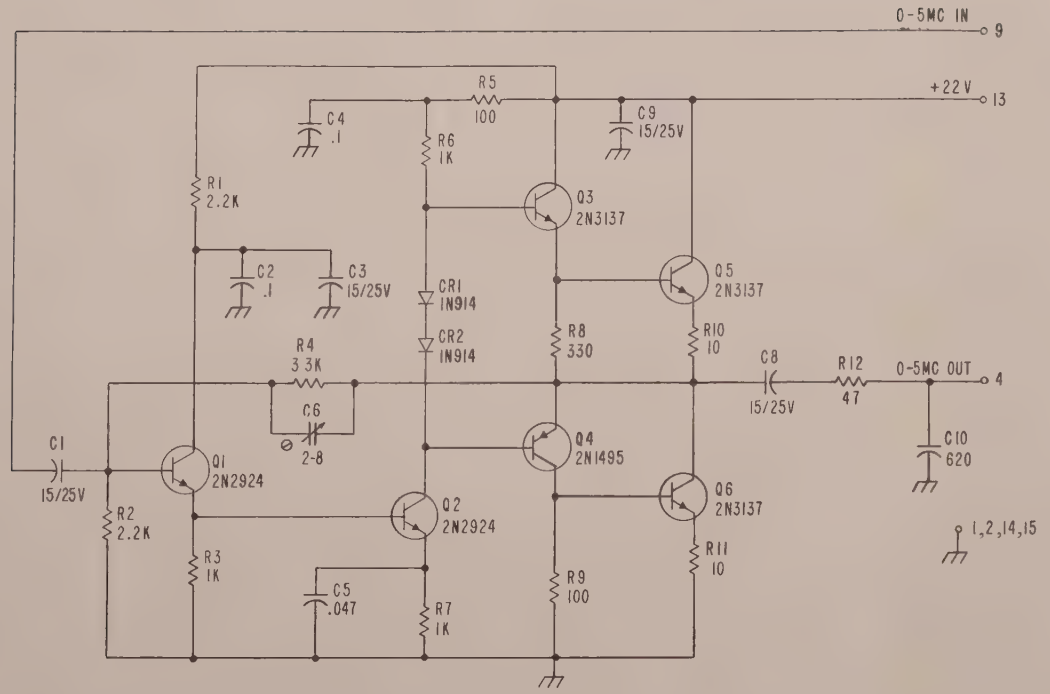


Figure 29-1. Schematic Diagram

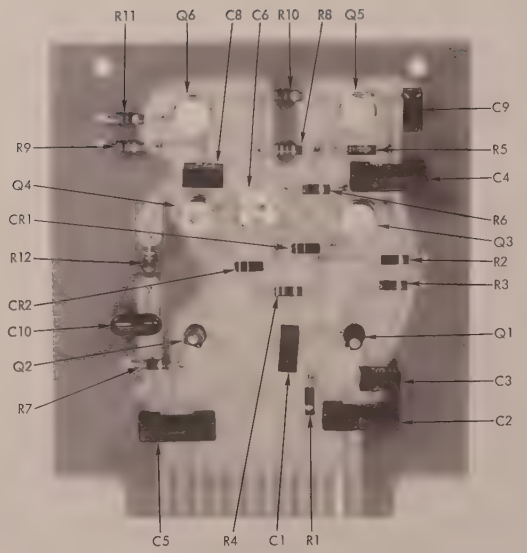


Figure 29-2. Parts Location

29-1. CIRCUIT DESCRIPTION.

29-2. The 10 KC to 5 MC amplifier is a complimentary, push-pull type used to provide broad band amplification. Negative feedback stabilizes the amplifier against variations in gain. Capacitor C6 compensates for gain variations over the frequency range. The inversion required for push-pull operation is obtained by using transistors of the opposite type (Q3 and Q4). Diodes CR1 and CR2 provide temperature stability.

29-3. TEST EQUIPMENT.

29-4. Refer to Table 29-1 for a list of test equipment.

29-5. CHECKOUT.

29-6. To checkout and adjust the video amplifier, proceed as follows:

a. Connect scope to the output (pin 4 of J1).

b. Set up the Model SSG-1 to produce a 10 KC output signal.

c. Check that output signal is 10 KC with an amplitude of 1.5V peak-to-peak ±.2V.

d. Repeat steps b and c at 1, 2, 3, 4, and 5 MC.

e. Adjust capacitor C6 as required to obtain an equal amplitude throughout the frequency range.

TABLE 29-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	10 KC to 5 MC, .1 to 5V peak-to-peak	
VTVM	.1 to 22 vdc	
Circuit Board Extender (Singer Part No. 1867)		

TABLE 29-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Supply voltage of 22 ±0.1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	4.5	3.4	13.5
Q2	3.4	3.2	11.7
Q3	13.	12.	22.
Q4	11.7	.3	11.5
Q5	12.	11.5	22.
Q6	.3	0	11.5

TABLE 29-3. DYNAMIC MEASUREMENTS

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
1. Supply Voltage	Pin 13	VTVM	+22 ±0.1 vdc	
2. Input Signal	Pin 9	Scope	.1V peak-to-peak	Frequency determined by setting of SSG-1.

TABLE 29-3. DYNAMIC MEASUREMENTS (CONT)

ITEM	MEASURE POINT	TEST EQUIPMENT	TYPICAL MEASUREMENT	NOTES
3. Output of Q1	Emitter of Q1	Scope	.08V peak-to-peak	
4. Output of Q2	Collector of Q2	Scope	4V peak-to-peak	
5. Output of Q3	Emitter of Q3	Scope	4V peak-to-peak	
6. Output of Q4	Collector of Q4	Scope	.9V peak-to-peak semi-square wave	
7. Output	Pin 4	Scope	1.5V peak-to-peak sine wave	

SECTION XXX

BEAT DETECTOR
A28

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C2	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C3	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C4	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C5	Capacitor, mylar, 0.001 uf ±10%, 50V	Paktron	MR330-.001
C6	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C7	Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
C8	Capacitor, mica, 330 pf ±5%	Elmenco	DM15E331J
C9	Capacitor, mica, 250 pf ±5%	Elmenco	DM15E251J
C10	Capacitor, mica, 470 pf ±5%	Elmenco	DM15E471J
C11	Capacitor, mylar, 0.01 uf ±10%	Paktron	MR330-.01
C41	Capacitor, feed-thru, 0.001 uf	Allen-Bradley	FB2B-102W
J41	Connector, BNC		UG-604/U
J42	Connector, BNC, 90°		UG-1098/U
J43	Connector	Microdot	31-49
J44	Jack, phono	Lab-Tronics	S-PM-1
J45	Jack, phono	Lab-Tronics	S-PM-1
L1	Inductor, variable	Singer	LR-25-4
L2	Inductor, 2.5 mh	Miller	70F253A1
Q1	Transistor		2N2924
Q2	Transistor		2N3563
R1	Resistor, fixed, composition, 1K ±10%, 1/4W		
R2	Resistor, fixed, composition, 330 ohms ±10%, 1/4W		
R3	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R4	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R5	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R6	Resistor, fixed, composition, 82K ±10%, 1/4W		
R7	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R8	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R9	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R10	Resistor, fixed, composition, 680K ±10%, 1/4W		
R11	Resistor, fixed, composition, 39K ±10%, 1/4W		
R12	Resistor, fixed, composition, 10K ±10%, 1/4W		
R13	Resistor, fixed, composition, 680 ohms ±10%, 1/4W		
R14	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		

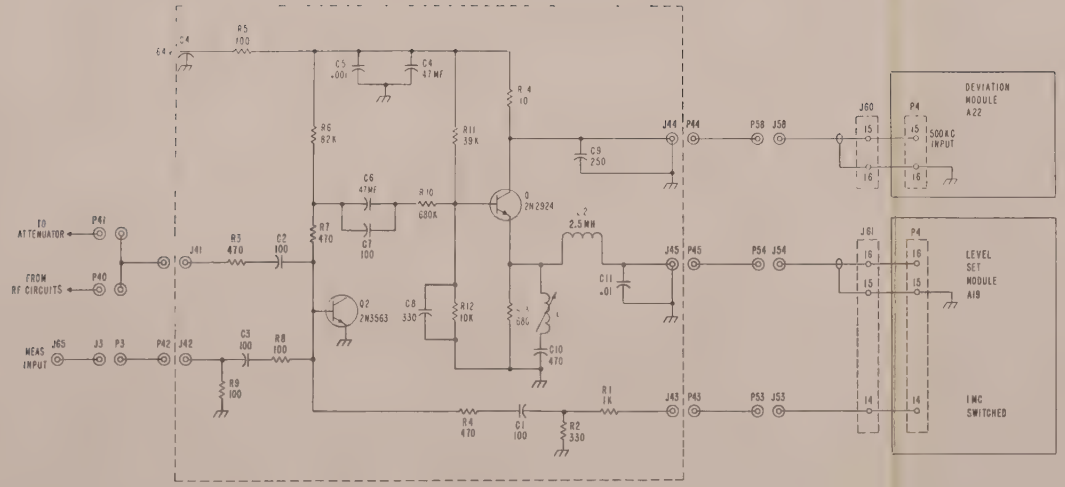


Figure 30-1. Schematic Diagram

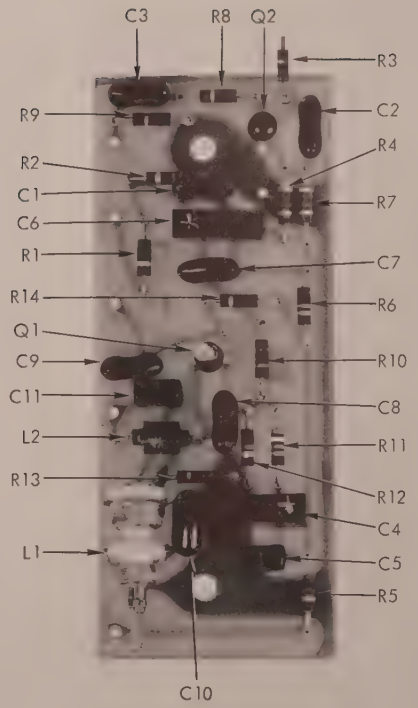


Figure 30-2. Parts Location (Sheet 1 of 2)

30-1. GENERAL.

30-2. FREQUENCY METER MODE. The unknown frequency is compared to the known frequency of the Model SSG-1 in the beat detector. The resultant beat notes are supplied to the audio circuits of the level set module.

30-3. DEVIATION METER MODE. The Model SSG-1 rf circuits function as a local oscillator and are set to produce a 500 KC difference frequency. The difference frequency is detected by the beat detector and applied to the deviation module.

30-4. LOW FREQUENCY (5 CPS TO 10 KC) OPERATION. A 1.000005 to 1.010000 MC signal is supplied by the rf circuits and a fixed 1 MC signal is supplied from the crystal circuit. The 5 cps to 10 KC difference is applied to the audio circuits of the level set module.

30-5. CIRCUIT DESCRIPTION.

30-6. Each of the three input signals is applied through an impedance and level matching circuit. Transistor Q2 operates as a diode and provides half-wave rectification. The low frequency output to the level set module is applied through a filter. The 500 KC output to the deviation module is unfiltered.

30-7. TEST EQUIPMENT.

30-8. Refer to Table 30-1 for a list of test equipment.

30-9. CHECKOUT.

30-10. To checkout the level set module, proceed as follows:

a. Operate Model SSG-1 in the GEN-LOW mode to provide a 1 KC output signal.

b. Make certain the RF OUTPUT meter deflects to the LEVEL SET marking. Readjust RF LEVEL control, if required.

c. Connect oscilloscope to the low frequency output (J45 or C11).

d. The output shall be 1 KC with an amplitude of .12 volt peak-to-peak ±.02V.

TABLE 30-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Oscilloscope	1 to 2 MC, .1 to 4V peak-to-peak	
VTVM	.1 to 6 vdc	

TABLE 30-2. TYPICAL DC VOLTAGES

CONDITIONS:

a. Measured with VTVM.

b. Supply voltage of +6 vdc ±0.1 vdc.

TRANSISTOR	BASE	EMITTER	COLLECTOR
Q1	1	.4	5.9
Q2	.5	0	-

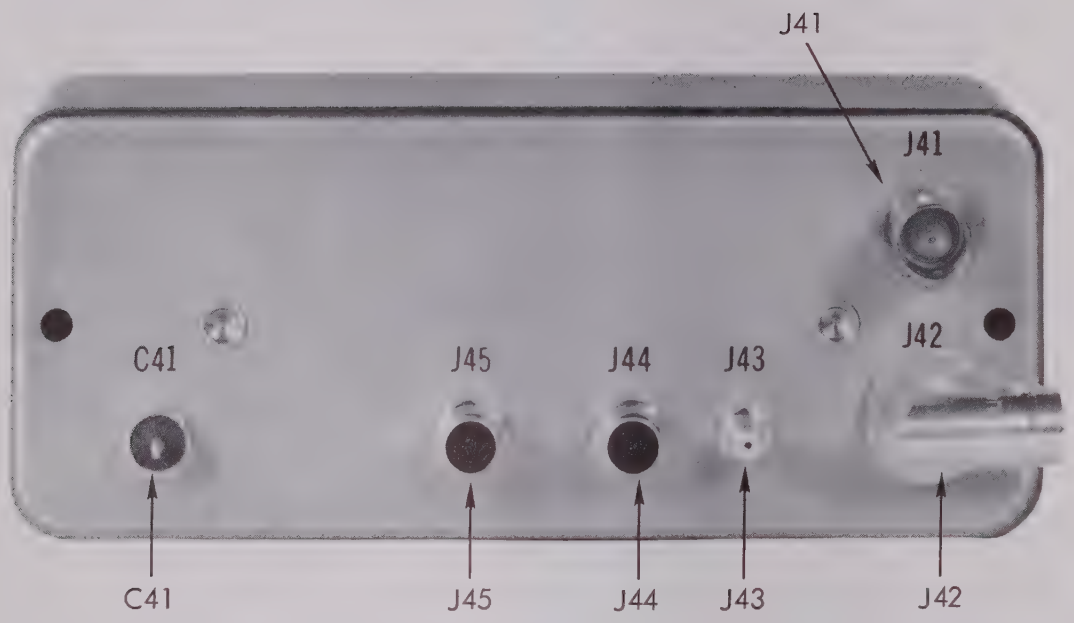


Figure 30-2. Parts Location (Sheet 2 of 2)

SECTION XXXI

HFO
(See figure 31-2)

REF DESIG	ITEM	MFR	PART NO.
A36	HFO Buffer (See Section 36)	Singer	AA-1236
A37	Reference Voltage (See figure 31-3)	Singer	AA-1237
A38	Tuner, Band 6, 31 to 50 mc (See figure 33-3)	Singer	AA-1225-5
A39	Tuner, Band 5, 20 to 32 mc (See figure 33-3)	Singer	AA-1225-4
A40	Tuner, Band 4, 13 to 21 mc (See figure 33-3)	Singer	AA-1225-3
A41	Tuner, Band 3, 8 to 13 mc (See figure 33-3)	Singer	AA-1225-1
A42	Tuner, Band 2, 5 to 8 mc (See figure 33-3)	Singer	AA-1225-2
A43	Tuner, Band 1, 8 to 13 mc (See figure 33-3)	Singer	AA-1225-1
A44	HFO, Band 6, 31 to 50 mc (See Section 32)	Singer	AA-1222-5
A45	HFO, Band 5, 20 to 32 mc (See Section 32)	Singer	AA-1222-4
A46	HFO, Band 4, 13 to 21 mc (See Section 32)	Singer	AA-1222-3
A47	HFO, Band 3, 8 to 13 mc (See Section 32)	Singer	AA-1222-2
A48	HFO, Band 2, 5 to 8 mc (See Section 32)	Singer	AA-1222-1
A49	HFO, Band 1, 8 to 13 mc (See Section 32)	Singer	AA-1222-2
C28	Capacitor, variable	Singer	SC-525
C29	Capacitor, variable	Singer	SC-525
C34	Capacitor, variable	Singer	SC-525
E5	Contact Assy	Singer	AA-1207
E6	Contact Assy	Singer	AA-1207

REFERENCE VOLTAGE
A37
(See figure 31-3)

REF DESIG	ITEM	MFR	PART NO.
C78	Capacitor, paper, 0.5 uf	Hopkins	P52DS
R1	Resistor, fixed, composition, 10K ±10%, 1/4W		
R2	Resistor, variable, 20K	Bourns	3068P-1-203
R3	Resistor, fixed, composition, 10K ±10%, 1/4W		

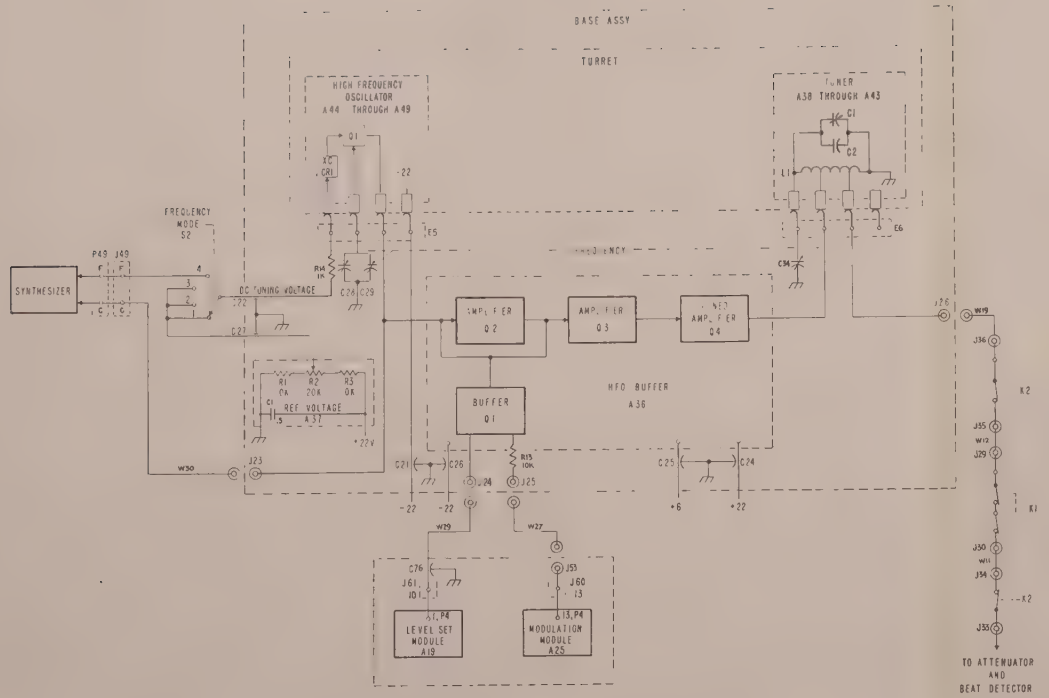


Figure 31-1. Schematic Diagram

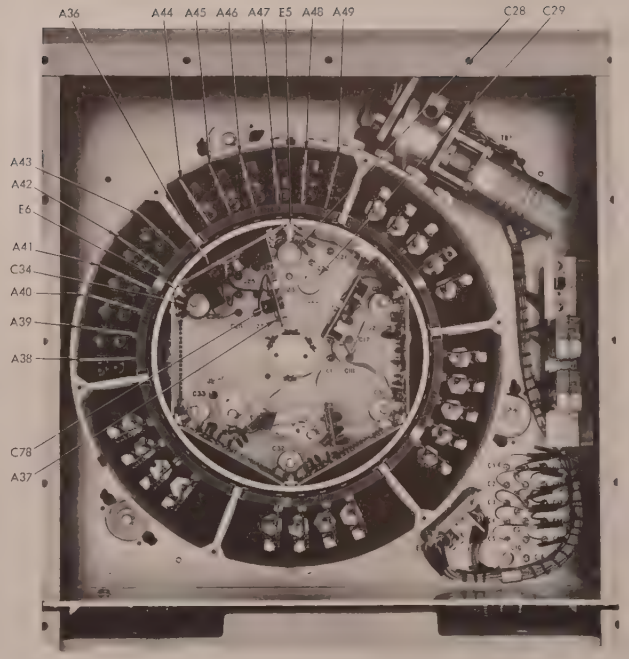


Figure 31-2. Parts Location

31-1. GENERAL.

31-2. This section contains general information covering the HFO circuits. For detail information on the various individual circuits, refer to the following sections:

a. High frequency oscillators A44 through A49, see Section XXXII.

b. HFO buffer A36, see Section XXXIII.

31-3. CIRCUIT DESCRIPTION.

31-4. The Model SSG-1 is set to an exact frequency by a three-step tuning process:

a. In the first step, the turret is set to one of six positions by the BAND SELECT switch. Six high frequency oscillator circuits and six tuners for the HFO buffer are located in the turret. The oscillator and tuner for the selected frequency band are connected into the circuit by the appropriate contact assembly.

b. In the second step, the high frequency oscillator and the tuner are set to an approximate frequency by the FREQUENCY control. The FREQUENCY control is a gang tuning mechanism and tunes capacitors C28 and C29 of the high frequency oscillator circuit and capacitor C34 of the HFO buffer circuit.

c. In the final step, the high frequency oscillator is set to an exact frequency by a dc tuning voltage from the synthesizer. The dc voltage is applied to a capacitor element CR1 in the oscillator tank circuit. The capacitor element is voltage sensitive (capacity varies with voltage) and therefore the dc voltage functions as a tuning voltage.

31-5. When FREQUENCY MODE switch S2 is turned to the FREE or the SET UP position, a fixed dc tuning voltage is supplied to the high frequency oscillator by reference voltage circuit A37. The circuit is a resistive voltage divider and supplies a fixed dc voltage to tune the oscillator.

31-6. When switch S2 is turned to the LOCK position, the output frequency of the high frequency oscillator is fed back to the synthesizer. The HFO frequency is compared to the control frequency through a phase detector system. The phase detector produces the dc tuning voltage.

31-7. The signal from the HFO is amplified by the three amplifier stages of HFO buffer A36. AGC voltage from the level set is applied through a buffer to the first amplifier stage. Modulation is also applied through the buffer to the first amplifier stage.

31-8. TEST EQUIPMENT.

31-9. Refer to Table 31-1 for a list of test equipment.

31-10. ADJUSTMENTS.

31-11. To adjust the HFO circuits, proceed as follows:

a. Connect VTVM to C27.

b. Check that reference voltage is +11 ±0.1 vdc. If necessary, adjust resistor R2 of reference voltage circuit A37.

c. Connect frequency meter to connector J23.

d. Operate Model SSG-1 in the FREE mode.

e. Set Model SSG-1 to 10 KC.

f. The HFO frequency shall be 8.01 MC ±1%. (Using the fourth harmonic, the frequency meter shall indicate 32.04 MC ±1%.)

g. If necessary, adjust transformer T1 of the HFO for band 1 (A49).

h. Set Model SSG-1 to 5 MC on band 1 (10 KC to 5 MC).

i. The HFO frequency shall be 13 MC ±1%. (Using the second harmonic, the frequency meter shall indicate 26 MC.

j. If necessary, adjust capacitor C7 of the HFO for band 1 (A49).

k. Repeat steps e through j for each band. Refer to Table 31-2.

l. Connect oscilloscope to the output of the HFO buffer (J26).

TABLE 31-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Frequency Meter (Gertsch Model FM-6)	5 to 50 MC range	
Oscilloscope	5 to 50 MC range	
	1 volt peak-to-peak	
VTVM	1 to 22 vdc	

m. Set the Model SSG-1 to 10 KC.

n. The buffer output shall be .7 volt peak-to-peak ±.05 volt at a frequency of 8.01 MC.

o. If necessary, adjust coil L1 of the HFO tuner for band 1 A43 (see Section XXXIII).

p. Set the Model SSG-1 to 5 MC on band 1.

q. The buffer output shall be .7 volt peak-to-peak ±0.05 volt at a frequency of 13 MC.

r. If necessary, adjust capacitor C1 of the HFO tuner for band 1.

s. Repeat steps l through r for each band. Refer to Table 31-3.

TABLE 31-2. HFO END POINT ADJUSTMENTS

BAND	HFO CIRCUIT BOARD	LOW POINT (T1)		HIGH POINT (C7)	
		SSG-1	FREQUENCY METER	SSG-1	FREQUENCY METER
1	A49	8.01 MC	24.04 MC	13 MC	26 MC
2	A48	5 MC	20 MC	8 MC	24 MC
3	A47	8 MC	24 MC	13 MC	26 MC
4	A46	13 MC	26 MC	21 MC	21 MC
5	A45	20 MC	20 MC	32 MC	32 MC
6	A44	31 MC	31 MC	50 MC	25 MC

TABLE 31-3. TUNER END POINT ADJUSTMENTS

BAND	TUNER BOARD	LOW POINT L1	HIGH POINT C1
1	A43	8.01 MC	13 MC
2	A42	5 MC	8 MC
3	A41	8 MC	13 MC
4	A40	13 MC	21 MC
5	A39	20 MC	32 MC
6	A38	31 MC	50 MC

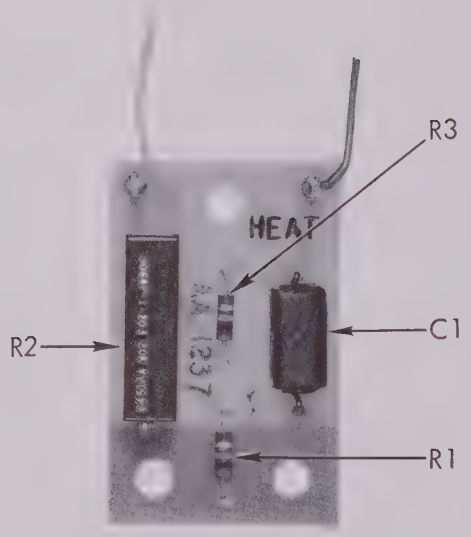


Figure 31-3. Parts Location

SECTION XXXII

HIGH FREQUENCY OSCILLATOR
A71

REFERENCE DESIGNATION						ITEM	MFR	PART NO.
A44	A45	A46	A47	A48	A49			
C1	C1	C1	C1	C1	C1	Capacitor, mylar, 0.0047 uf ±10%	Paktron	MR330-.0047
C2	C2	C2	C2	C2	C2	Capacitor, mylar, 0.0047 uf ±10%	Paktron	MR330-.0047
C3						Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
	C3					Capacitor, mica, 27 pf ±5%	Elmenco	DM15E270J
		C3				Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
			C3	C3	C3	Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
C4		C4				Capacitor, mica, 220 pf ±5%	Elmenco	DM15E221J
	C4		C4			Capacitor, mica, 300 pf ±5%	Elmenco	DM15E301J
				C4		Capacitor, mica, 1000 pf ±5%	Elmenco	DM15E102J
					C4	Capacitor, mica, 360 pf ±5%	Elmenco	DM15E361J
C5						Capacitor, mica, 22 pf ±5%	Elmenco	DM15E220J
	C5					Capacitor, mica, 33 pf ±5%	Elmenco	DM15E330J
		C5				Capacitor, mica, 56 pf ±5%	Elmenco	DM15E560J
				C5		Capacitor, mica, 100 pf ±5%	Elmenco	DM15E101J
			C5		C5	Capacitor, mica, 82 pf ±5%	Elmenco	DM15E820J
C6	C6	C6	C6	C6	C6	Capacitor, mica, 620 pf ±5%	Elmenco	DM15E621J
C7	C7					Capacitor, variable 5.5 to 18 pf, NPO	Erie	538-006C0P092R
		C7	C7	C7	C7	Capacitor, variable, 2 to 8 pf, NPO	Erie	538-006C0P089R
C8	C8	C8	C8	C8	C8	Capacitor, selected value, may be omitted		
CR1	CR1	CR1	CR1	CR1	CR1	Diode, capacitive reactance	Philco	V4090
Q1	Q1					Transistor		2N3563
		Q1	Q1	Q1	Q1	Transistor	Amperex	ME217
R1	R1	R1	R1	R1	R1	Resistor, comp, 1K ±10%, 1/4W		
R2	R2	R2	R2	R2	R2	Resistor, comp, 6.8K ±10%, 1/4W		
R3	R3	R3	R3	R3	R3	Resistor, comp, 6.8K ±10%, 1/4W		
R4	R4	R4	R4	R4	R4	Resistor, comp, 3.3K ±10%, 1/4W		
R5	R5	R5	R5	R5	R5	Resistor, comp, 6.8K ±10%, 1/4W		
	R6	R6				Resistor, comp, 1 Meg ±10%, 1/4W (located on back of board)		

REFERENCE DESIGNATION						ITEM	MFR	PART NO.
A44	A45	A46	A47	A48	A49			
T1						Transformer	Singer	LR-15
	T1					Transformer	Singer	LR-14
		T1				Transformer	Singer	LR-13
			T1		T1	Transformer	Singer	LR-12
				T1		Transformer	Singer	LR-11

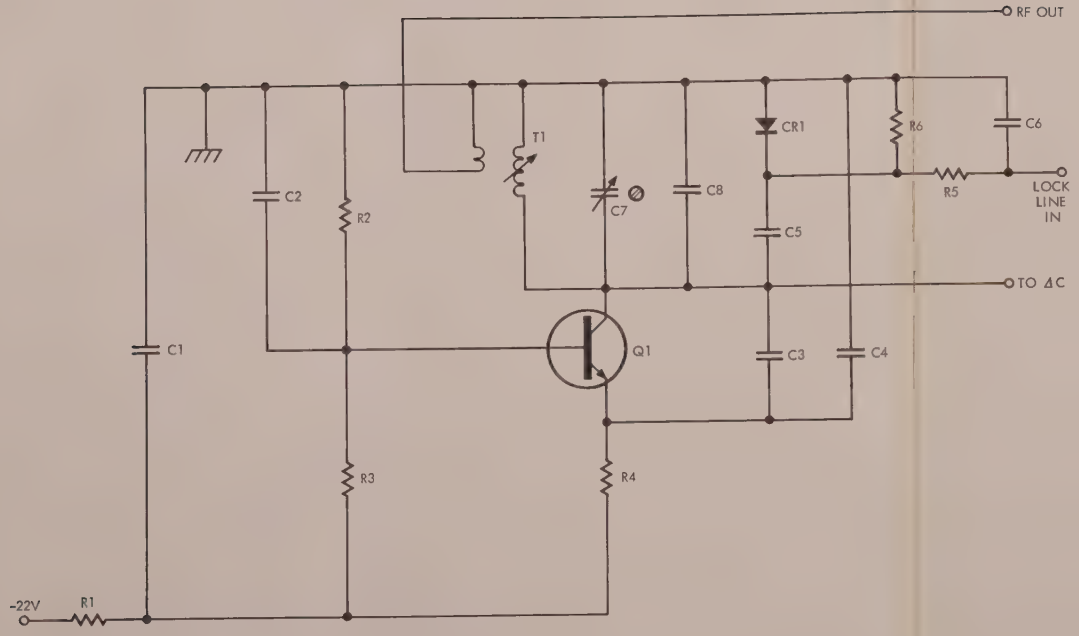


Figure 32-1. Schematic Diagram

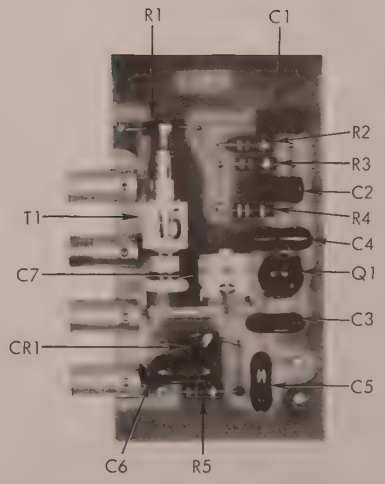


Figure 32-2. Parts Location

32-1. GENERAL.

32-2. The high frequency oscillator operates in a grounded base configuration with a reactance diode in the collector tank circuit. Refer to Section XXXI for adjustment and maintenance data.

SECTION XXXIII

HFO BUFFER
(See figure 33-2)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, electrolytic, 150 uf ±20%, 10V	Goodall	931-150-10-20
C2	Capacitor, mica, 500 pf ±10%	Elmenco	DM15E501J
C3	Capacitor, mylar, 0.0047 uf ±10%, 50V	Paktron	MR330-.0047
C4	Capacitor, mylar, 0.0047 uf ±10%, 50V	Paktron	MR330-.0047
C5	Capacitor, mica, 24 pf ±5%	Elmenco	DM15E240J
C6	Capacitor, mica, 500 pf ±5%	Elmenco	DM15E501J
C7	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C8	Capacitor, mylar, 0.0047 uf ±10%, 50V	Paktron	MR330-.0047
C9	Capacitor, mica, 500 pf ±5%	Elmenco	DM15E501J
C10	Capacitor, electrolytic, 47 uf ±20%, 25V	Goodall	931-47-25-20
C11	Capacitor, mylar, 0.0047 uf ±10%, 50V	Paktron	MR330-.0047
C12	Capacitor, mylar, 0.0047 uf ±10%, 50V	Paktron	MR330-.0047
C13	Capacitor, mica, 1000 pf ±5%	Elmenco	DM15E102J
L1	Coil, 1 uh	Miller	4602
Q1	Transistor	Amperex	ME217
Q2	Transistor		2N3137
Q3	Transistor		2N3137
Q4	Transistor		2N3137
R1	Resistor, 470 ohms		
R2	Resistor, 100 ohms		
R3	Resistor, 2.2K		
R4	Resistor, 47 ohms		
R5	Resistor, 1K		
R6	Resistor, 100 ohms		
R7	Resistor, 470 ohms		
R8	Resistor, 150 ohms		
R9	Resistor, 1K		
R10	Resistor, 100 ohms		
R11	Resistor, 470 ohms		
R12	Resistor, 150 ohms		
R13	Resistor, 1.2K		
R14	Resistor, 270 ohms		
R15	Resistor, 150 ohms		
R16	Resistor, 47 ohms		
R17	Resistor, 470 ohms		

TUNER
A38 through A43
(See figure 33-3)

REFERENCE DESIGNATION						ITEM	MFR	PART NO.
A38	A39	A40	A41	A42	A43			
C1	C1	C1	C1	C1	C1	Capacitor, variable, 5.5 to 18 pf	Erie	538-006C0P092R
C2						Capacitor, mica, 10 pf ±5%	Elmenco	DM15E100J
		C2				Capacitor, mica, 15 pf ±5%	Elmenco	DM15E150J
	C2		C2	C2	C2	Capacitor, mica, 5 pf ±5%	Elmenco	DM15E050J
L1						Coil	Singer	LR20
	L1					Coil	Singer	LR19
		L1				Coil	Singer	LR18
			L1		L1	Coil	Singer	LR17
				L1		Coil	Singer	LR16
TB1	TB1	TB1	TB1	TB1	TB1	Board Assy	Singer	AA-1223-2

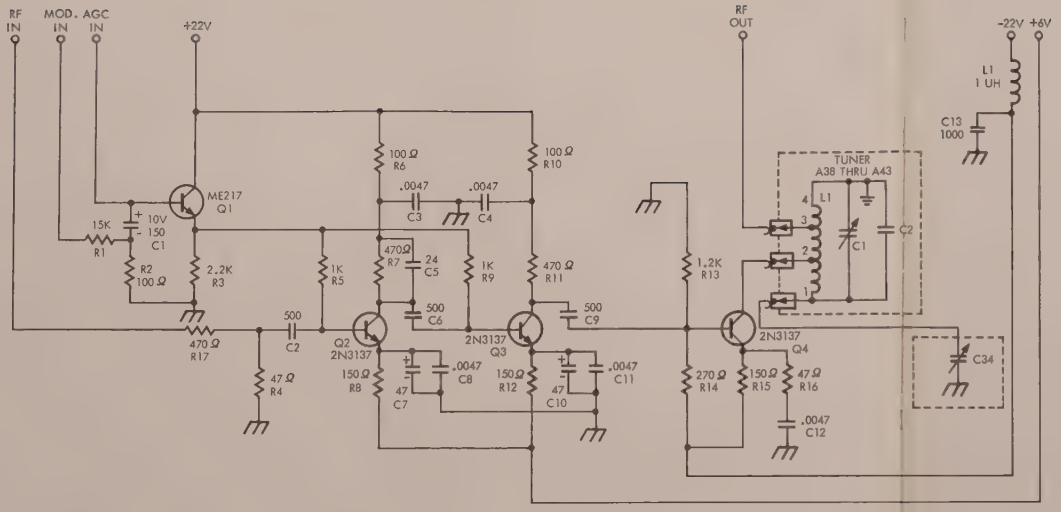


Figure 33-1. Schematic Diagram

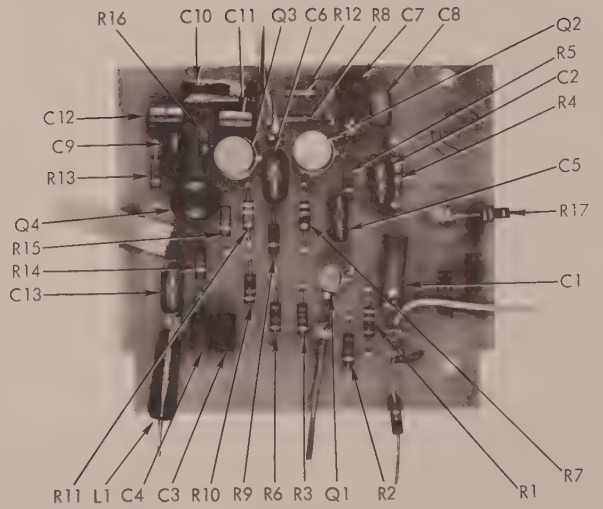


Figure 33-2. Parts Location

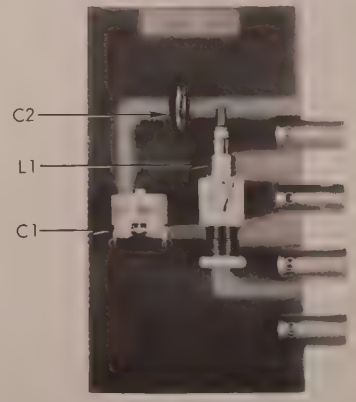


Figure 33-3. Parts Location

33-1. GENERAL.

33-2. The HFO buffer A36 consists of a three stage amplifier Q2, Q3, and Q4 and a buffer Q1 for injecting AGC voltage and modulation. Refer to Section XXXI for adjustment and maintenance data.

SECTION XXXIV

50 TO 320 MC CIRCUITS
(See figure 34-2)

REF DESIG	ITEM	MFR	PART NO.
A30	Modulator (See Section 36)	Singer	AA-1233
A31	Multiplier (See figure 34-4)	Singer	AA-1230
A32	Amplifier (See figure 34-5)	Singer	AA-1232
A33	Amplifier (See figure 34-5)	Singer	AA-1231
A51	Tuner, 200 to 320 mc	Singer	AA-1239-1
A52	Tuner, 130 to 210 mc	Singer	AA-1239-4
A53	Tuner, 80 to 130 mc	Singer	AA-1239-5
A54	Tuner, 50 to 80 mc	Singer	AA-1239-3
A56	Tuner, 200 to 320 mc	Singer	AA-1239-4
A57	Tuner, 130 to 210 mc	Singer	AA-1240-1
A58	Tuner, 80 to 130 mc	Singer	AA-1240-2
A59	Tuner, 50 to 80 mc	Singer	AA-1240-3
A60	Tuner, 200 to 320 mc	Singer	AA-1239-4
A61	Tuner, 130 to 210 mc	Singer	AA-1240-4
A62	Tuner, 80 to 130 mc	Singer	AA-1240-5
A63	Tuner, 50 to 80 mc	Singer	AA-1240-6
A64	Tuner, 200 to 320 mc	Singer	AA-1239-4
A65	Tuner, 130 to 210 mc	Singer	AA-1240-7
A66	Tuner, 80 to 130 mc	Singer	AA-1240-8
A67	Tuner, 50 to 80 mc	Singer	AA-1240-9
C30	Capacitor, variable	Singer	SC-524
C31	Capacitor, variable	Singer	SC-524
C32	Capacitor, variable	Singer	SC-524
C33	Capacitor, variable	Singer	SC-524
E7	Contact Assy	Singer	AA-1207
E8	Contact Assy	Singer	AA-1207
E9	Contact Assy	Singer	AA-1207
E10	Contact Assy	Singer	AA-1207

MULTIPLIER BOARD
A31
(See figure 34-4)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C2	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C3	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C4	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C5	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C6	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C7	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C8	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C9	Capacitor, mica, 39 pf ±5%	Elmenco	DM15E390J
CR1	Diode	Hewlett-Packard	HPA0113
L1	Coil, 0.1 uh	Nytronics	DDO.10
Q1	Transistor	RCA	2N3600
Q2	Transistor	RCA	2N3600
R1	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 22 ohms ±10%, 1/4W		
R3	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R4	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R5	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R6	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R7	Resistor, fixed, composition, 12K ±10%, 1/4W		
R8	Resistor, fixed, composition, 10K ±10%, 1/4W		
R9	Resistor, fixed, composition, 1K ±10%, 1/4W		
R10	Resistor, fixed, composition, 100 ohms, 1/4W		
R11	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R12	Resistor, fixed, composition, 47 ohms ±10%, 1/4W		

(Continued on page 34-6)

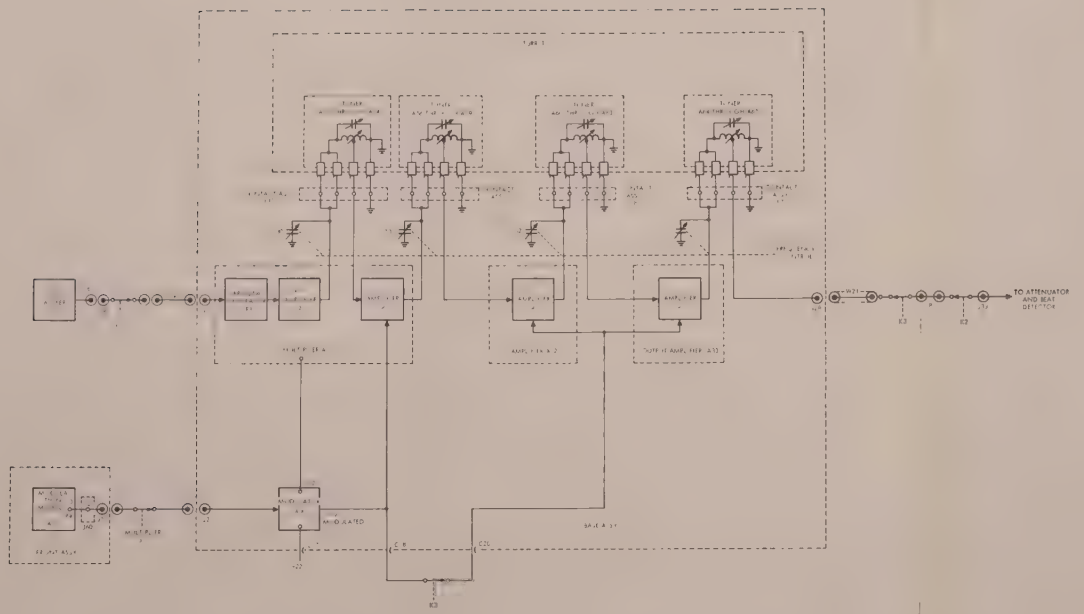


Figure 34-1. Block Diagram

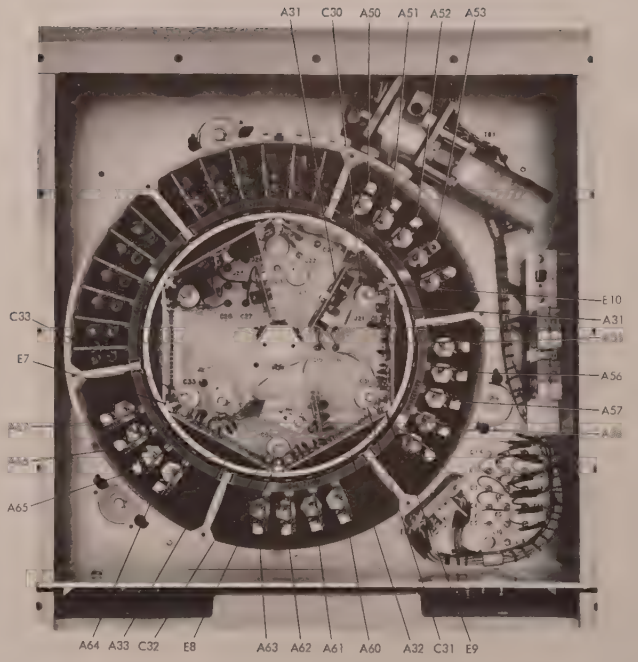


Figure 34-2. Parts Location

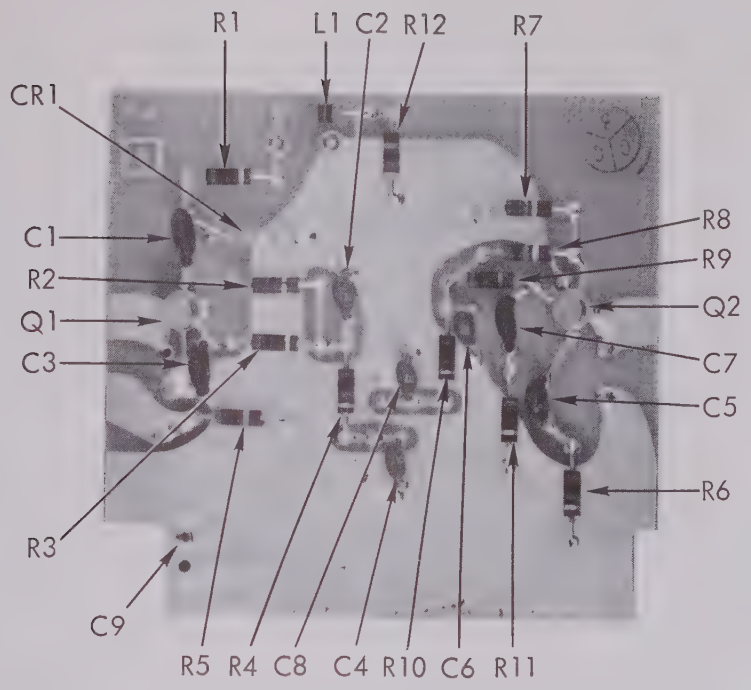


Figure 34-4. Parts Location

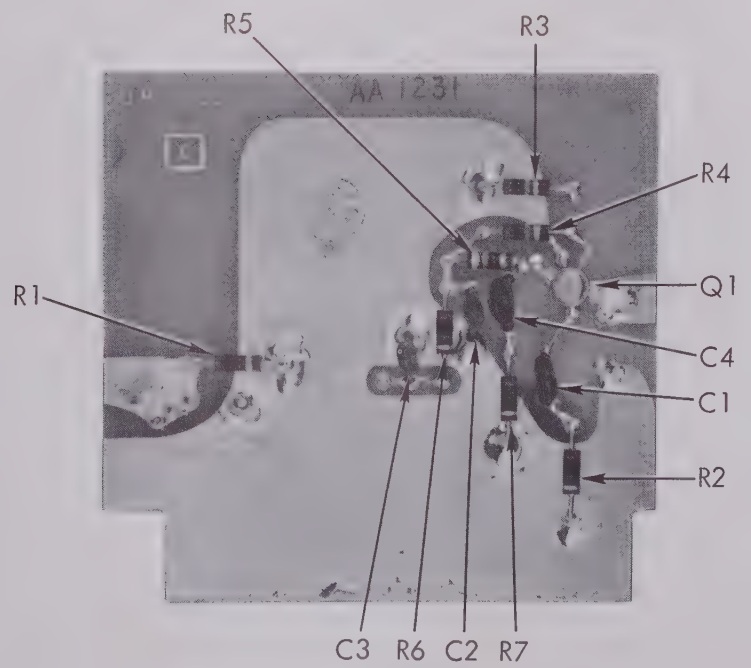


Figure 34-5. Parts Location

OUTPUT AMPLIFIER
A33
(See figure 34-5)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C2	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C3	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C4	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
Q1	Transistor	RCA	2N3600
R1	Resistor, fixed, composition, selected value, 10 to 27 ohms nominal		
R2	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R3	Resistor, fixed, composition, 12K ±10%, 1/4W		
R4	Resistor, fixed, composition, 10K ±10%, 1/4W		
R5	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R6	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R7	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		

IF AMPLIFIER
A32
(See figure 34-5)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C2	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C3	Capacitor, disc, 1000 pf ±10%	Erie	861Z5U102Z
C4	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
Q1	Transistor	RCA	2N3600
R1	Resistor, fixed, composition, selected value, 10 to 27 ohms nominal		
R2	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R3	Resistor, fixed, composition, 12K ±10%, 1/4W		
R4	Resistor, fixed, composition, 10K ±10%, 1/4W		
R5	Resistor, fixed, composition, 1K ±10%, 1/4W		
R6	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R7	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		

SECTION XXXV

310 TO 500 MC CIRCUITS
(See figure 35-2)

REF DESIG	ITEM	MFR	PART NO.
A30	Modulator (See Section 36)	Singer	AA-1233
A31	Multiplier (See figure 34-4)	Singer	AA-1230
A34	Doubler (See figure 35-4)	Singer	AA-1228-1
A35	Output Amplifier (See figure 35-4)	Singer	AA-1228-2
A51	Tuner	Singer	AA-1239-1
A55	Tuner	Singer	AA-1239-1
C30	Capacitor	Singer	SC-524
C51	Capacitor	Singer	SC-524
E9	Contact Assy	Singer	AA-1207
E10	Contact Assy	Singer	AA-1207

DOUBLER
A34
(See figure 35-4)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C2	Capacitor, mica, 10 pf	Elmenco	DM15E100J
C3	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C4	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C5	Capacitor, variable	Singer	SC-524
C6	Capacitor, variable, 2 to 8 pf	Erie	538-006NPO89R
L1	Trimmer, inductance	Singer	EP-79
Q1	Transistor	RCA	2N3600
R1	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 12K ±10%, 1/4W		
R3	Resistor, fixed, composition, 10K ±10%, 1/4W		
R4	Resistor, fixed, composition, 1K ±10%, 1/4W		
R5	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		

OUTPUT AMPLIFIER
A35
(See figure 35-4)

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C2	Not used		
C3	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C4	Capacitor, disc, 100 pf ±10%	Erie	831X5R100K
C5	Capacitor, variable	Singer	SC-524
C6	Capacitor, variable, 2 to 8 pf	Erie	538-006NPO89R
L1	Trimmer, inductance	Singer	EP-79
Q1	Transistor	RCA	2N3600
R1	Resistor, fixed, composition, 10 ohms ±10%, 1/4W		
R2	Resistor, fixed, composition, 12K ±10%, 1/4W		
R3	Resistor, fixed, composition, 10K ±10%, 1/4W		
R4	Resistor, fixed, composition, 470 ohms ±10%, 1/4W		
R5	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		

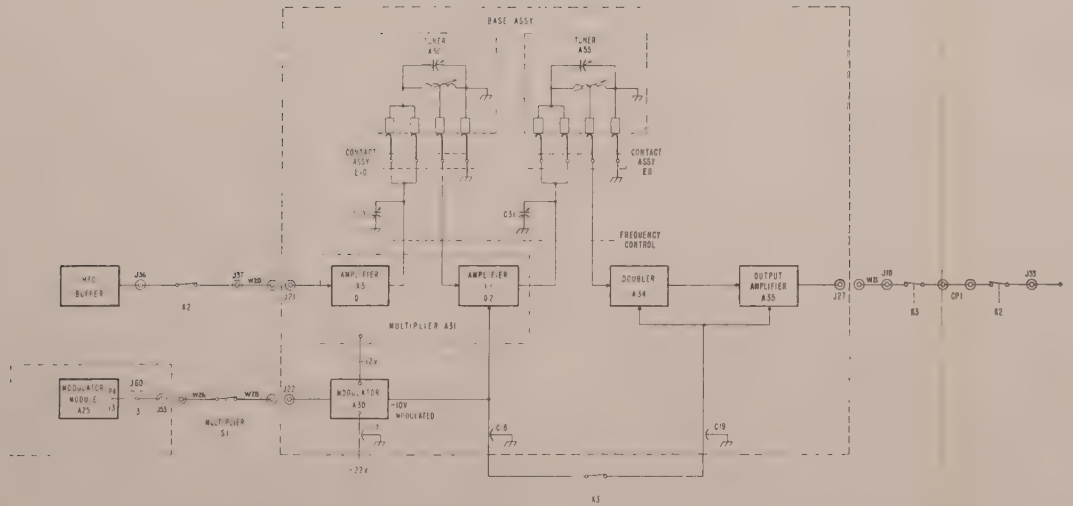


Figure 35-1. Schematic Diagram

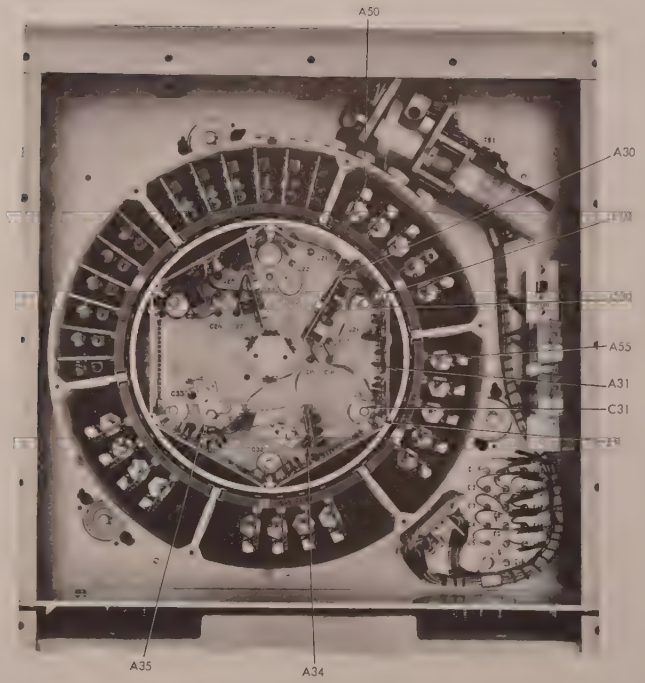


Figure 35-2. Parts Location

35-1. GENERAL.

35-2. This section contains general information covering the 310 to 500 MC circuits. Refer to figure 35-1 for a block diagram and to figure 35-3 for a schematic diagram. Refer to Section XXXVI for detail information on modulator A30.

35-3. CIRCUIT DESCRIPTION.

35-4. As with the 50 to 310 MC circuits (see Section XXXIV), the signal from the high frequency oscillator is multiplied by ten to provide the RF output signal. The signal from the HFO buffer is applied through the harmonic generator to amplifier Q1 of multiplier A31. This amplifier is tuned to the fifth harmonic by tuner A50 and capacitor C30. The signal from the X5 amplifier is applied to doubler A34 through amplifier Q2. The output of the doubler is applied to the output circuit through output amplifier A35.

35-5. Gain through the amplifier stages is fixed and therefore the output level is determined by the input level. The AGC circuit for the HFO (see Section XXXI) determines the input level and therefore functions as the level control for this frequency range.

35-6. As with the 50 to 310 MC circuits, modulation is applied through modulator A30.

35-7. TEST EQUIPMENT.

35-8. Refer to Table 35-1 for a list of test equipment.

35-9. ADJUSTMENTS.

35-10. To adjust the circuits, proceed as follows:

a. Connect sampling oscilloscope to the RF OUTPUT connector.

b. Operate the Model SSG-1 as a signal generator in the FREE mode at a frequency of 310 MC.

c. Set the attenuator to 0.

d. Turn the RF LEVEL control to the maximum clockwise position.

e. Set the MOD SELECT switch to CW.

f. Adjust the following for maximum undistorted output at 310 MC:

(1) Coil of tuner A50

(2) Coil of tuner A55

(3) Coil L1 of amplifier A34

(4) Coil L1 of amplifier A35

Make certain that the output is not modulated or shows any indication of ripple.

g. Operate the Model SSG-1 at 500 MC.

h. Adjust the following for maximum undistorted output at 500 MC:

(1) Capacitor of tuner A50

(2) Capacitor of tuner A55

(3) Capacitor C6 of amplifier A34

(4) Capacitor C6 of amplifier A35

i. Tune FREQUENCY control over the 310 to 500 MC. Check for distortion, ripple, or loss of amplitude throughout the range.

TABLE 35-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
Frequency Meter (Gertsch Model FM-6)	310 to 500 MC range	
Oscilloscope	310 to 500 MC range	A high frequency sampling oscilloscope is required.
VTVM	1 to 22 vdc	

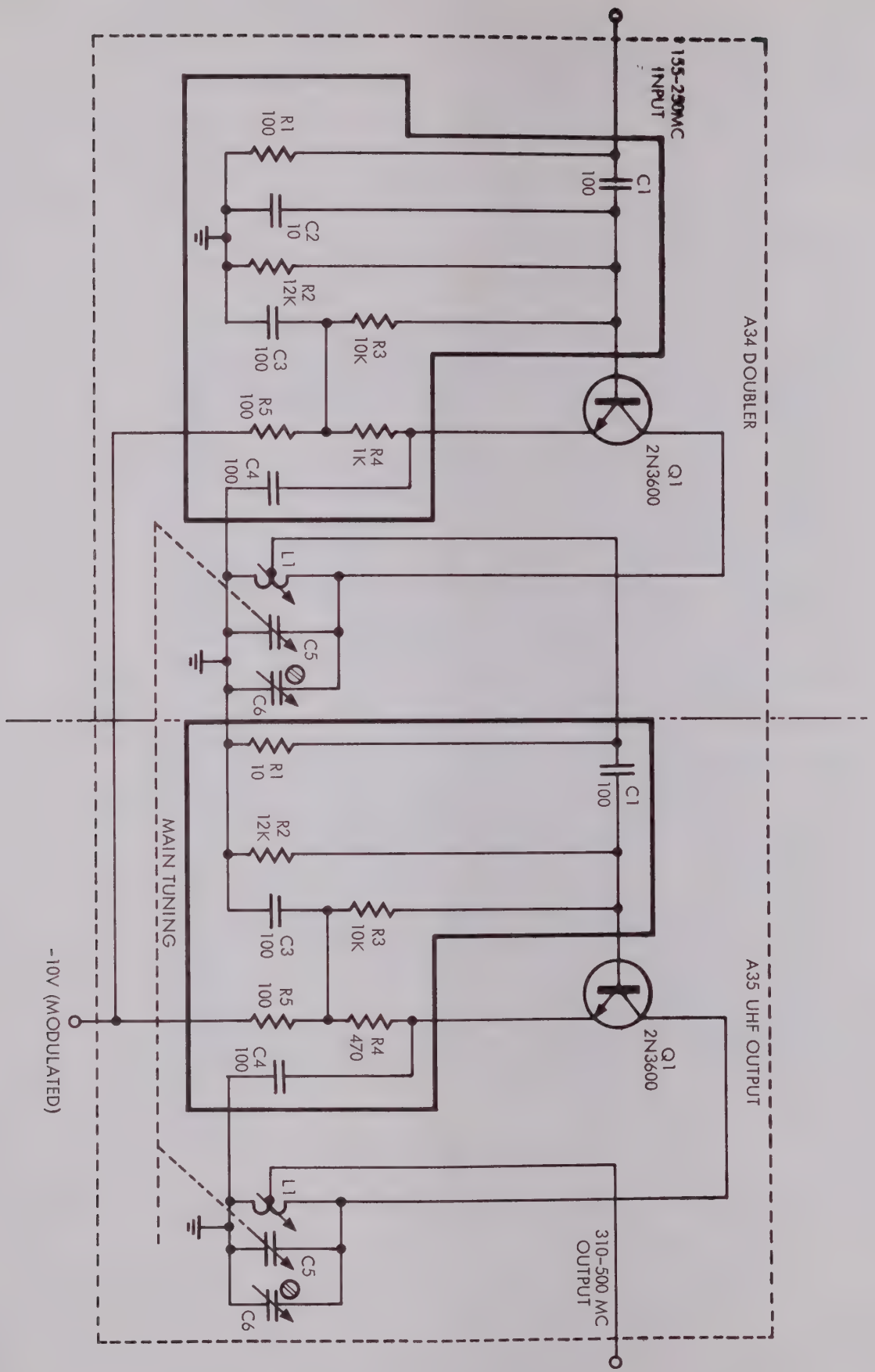


Figure 35-3. Schematic Diagram

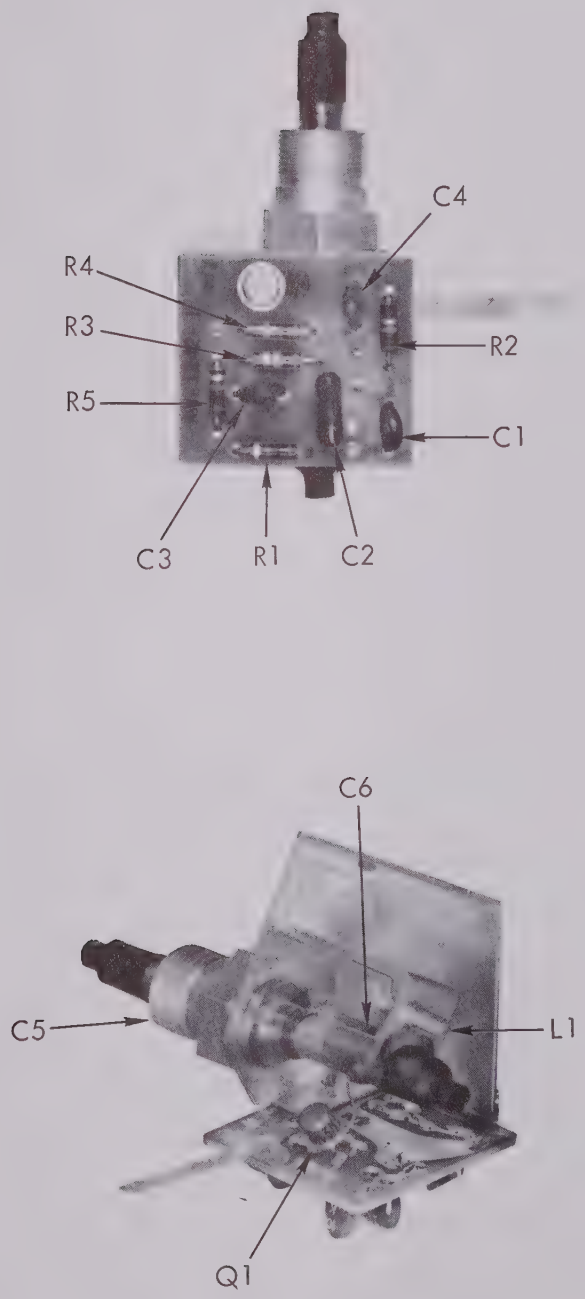


Figure 35-4. Parts Location

SECTION XXXVI

MODULATOR
A30

REF DESIG	ITEM	MFR	PART NO.
C1	Capacitor, electrolytic, 6.8 uf	Goodall	931-6.8-35-20
C2	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C3	Capacitor, mylar, 0.01 uf ±10%, 50V	Paktron	MR330-.01
C4	Capacitor, electrolytic, 6.8 uf ±20%, 35V	Goodall	931-6.8-35-20
CR1	Diode, Zener, 12V	Motorola	1/4M12Z5
Q1	Transistor		2N3250
Q2	Transistor		2N1184
R1	Resistor, fixed, composition, 3.3K ±10%, 1/4W		
R2	Resistor, fixed, composition, 2.7K ±10%, 1/4W		
R3	Resistor, fixed, composition, 4.7K ±10%, 1/4W		
R4	Resistor, fixed, composition, 100 ohms ±10%, 1/4W		
R5	Resistor, fixed, composition, 33K ±10%, 1/4W		
R6	Resistor, fixed, composition, 2.2K ±10%, 1/4W		

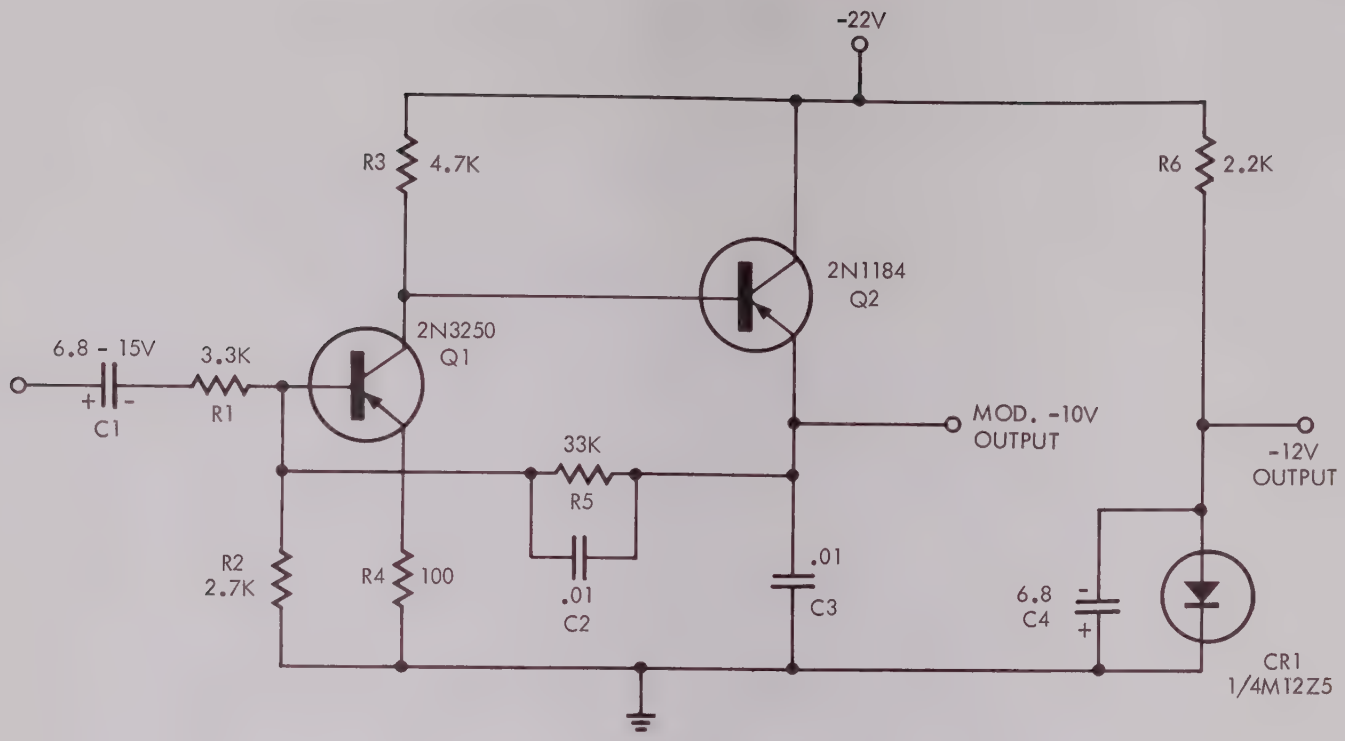


Figure 36-1. Schematic Diagram

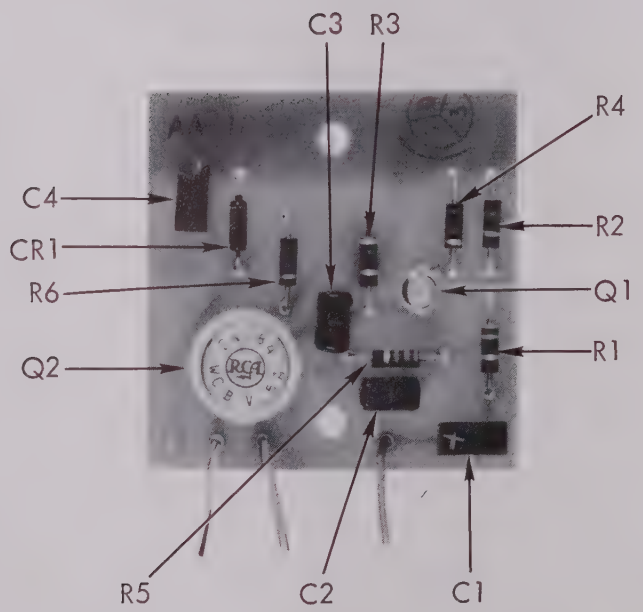


Figure 36-2. Parts Location

36-1. CIRCUIT DESCRIPTION.

36-2. Modulator A30 controls a -22V input to a regulated -12V supply and a modulated -10V supply. Both voltages are used by the 50 to 500 MC circuits.

36-3. The -12V supply is developed and regulated by zener diode CR1. The -10V supply is developed by transistors Q1 and Q2. When no modulation is applied, the two stages operate as a voltage regulator. When modulation is applied, the -10V supply varies at the modulation frequency.

36-4. TEST EQUIPMENT.

36-5. Refer to Table 36-1 for a list of test equipment.

36-6. TEST PROCEDURE.

36-7. To test the modulator, proceed as follows:

a. Operate the Model SSG-1 in the 50 to 500 MC range.

b. Turn the MOD SELECT switch to CW.

c. Measure voltage across diode CR1.

d. The voltage shall be -12V ±5%.

e. Measure voltage at the emitter of Q2.

f. The voltage shall be -10V ±5%.

TABLE 36-1. TEST EQUIPMENT

ITEM	REQUIREMENTS	NOTES
VTVM	1 to 22 vdc	

SECTION XXXVII

TURRET DRIVE ASSY

REF DESIG	ITEM	MFR	PART NO.
B1	Motor	Singer	SC-539
CR1	Diode	Semtec	SC-2
CR2	Diode	Semtec	SC-2
E1A	Contact Assy	Singer	AA-1209
E1B	Circuit Board	Singer	OM-1264
K4	Relay, 24 vdc	Allied Control	T154-CC-CC
K5	Relay, 24 vdc	Allied Control	T154-CC-CC
MP30	Spacer, motor mount (4 required)	Singer	OM-1309
MP31	Screw, mach, pan hd, cres, 6-32 by 1-3/16 in. lg (4 req)		
MP32	Cam	Singer	OM-1532
MP33	Setscrew, No. 4-40 by 1/8 in. lg	Long-Lok	LL57XD40K2
MP34	Cam	Singer	AC-129
MP35	Setscrew, No. 8-32 by 3/8 in. lg, Bristol		
MP36	Cam	Singer	OM-1313
MP37	Setscrew, No. 4-40 by 1/4 in. lg	Long-Lok	LL57D40K4
MP38	Spring, switch actuator	Singer	AS-1032
MP39	Roller (6 required)	Singer	OM-1474
MP40	Bushing (6 required)	Singer	OM-1300
MP41	Stud (6 required)	Singer	OM-1299
MP42	Bracket Assy (6 required)	Singer	AA-1226
MP43	Hub and Pulley Assy (3 required)	Singer	AA-1210
S4	Switch, slide	Muter	4603A2
S13	Switch	Licon	16-404
S14	Switch	Licon	16-404
S15	Switch	Micro-switch	111SM2-T2

37-1. CIRCUIT DESCRIPTION.

37-2. Turret motor B1 positions the turret in any one of six positions selected by switch S3. Through the clockwise and counterclockwise contacts of E1, the drive assembly uses the shortest route to a new position. Board removal switch S4 allows the turret to be positioned between contacts for servicing.

37-3. When switch S3 is turned to a new position, a circuit is completed through the switch and contact E1 to relay K4. The relay operates and in turn, closes the circuit to turret motor B1. Presuming that the shortest route is CCW, cam MP36 rotates in a CCW direction and actuates switch S14. The switch provides the closed circuit for the motor while the cam rotates a full revolution. At the end of the revolution, switch S3 and contact E1 provide the closed circuit.

37-4. Cam MP36 rotates a full revolution between turret positions. When the contact for the selected turret position is between the CW and CCW contacts of E1, the circuit for the motor is broken. Cam MP36 assures that the motor stops with the turret in proper position.

37-5. Switch S13 and relay K5 provide the circuit for clockwise rotation of the motor.

37-6. Cam MP32 (see figure 37-2) breaks switch S15 when the turret is between positions. When switch S4 is also open (board removal position), the motor circuit will break and stop the turret.

37-7. TEST PROCEDURE.

37-8. The only test of the drive system is to check that the turret rotates to all positions and may be placed in the board removal position. If troubles are encountered, check for mechanical interference or for defective electrical parts. Standard voltage and resistance checks may be used to check electrical parts.

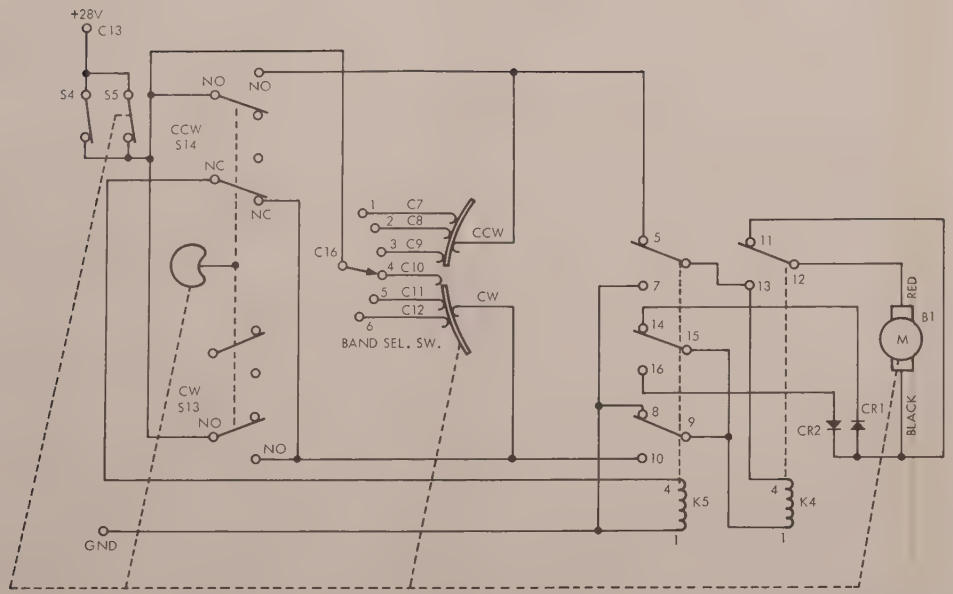


Figure 37-1. Schematic Diagram

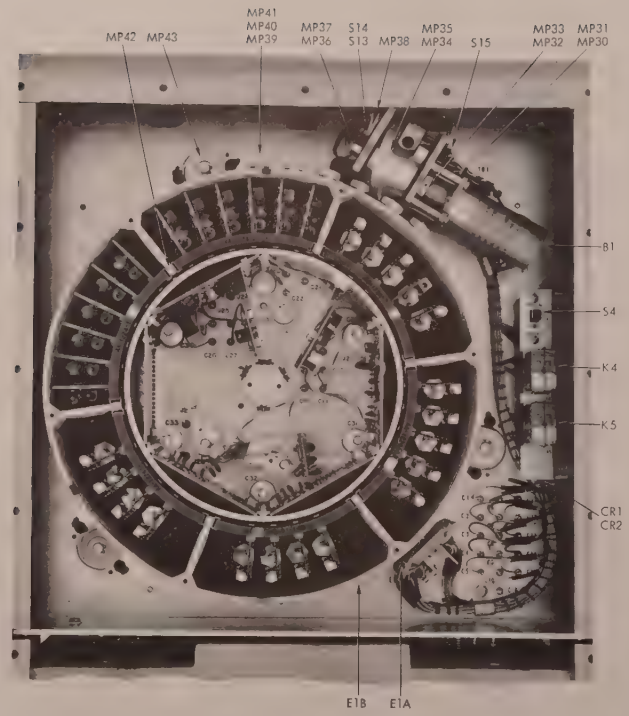


Figure 37-2. Parts Location

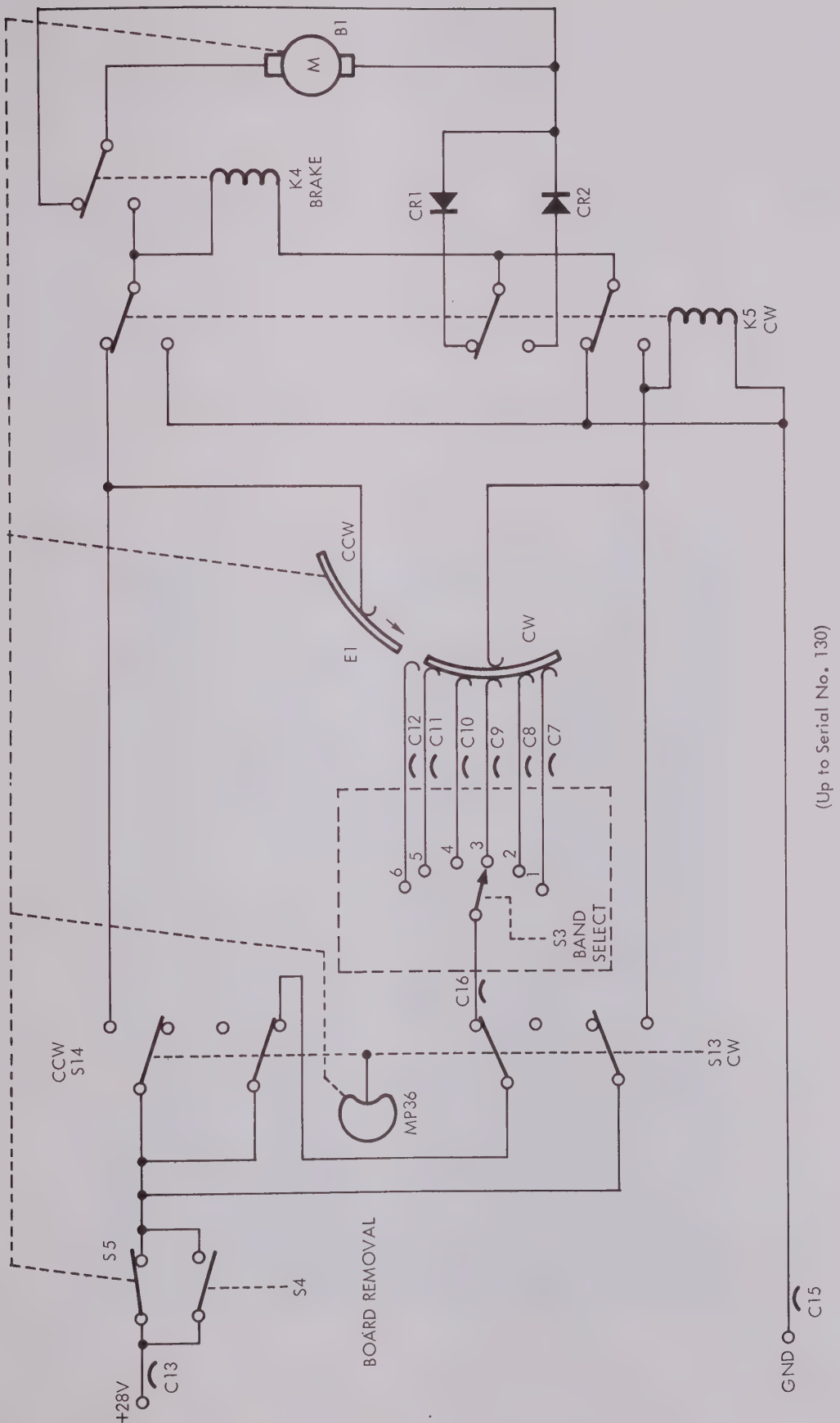


Figure 37-1A. Schematic Diagram

SECTION XXXVIII

MEGACYCLE CONTROL ASSEMBLY
(See figure 38-1)

REF DESIG	ITEM	MFR	PART NO.
A76	Capacitor Drive Assy (See figure 38-2)	Singer	AA-1177
A77	Dial Assembly (See figure 38-3)	Singer	AA-1172
MP50	Coupling	Singer	OM-1495
MP51	Adjustment Rod (5 required)	Singer	AA-1174-2
MP52	Adjustment Rod (4 required)	Singer	AA-1174-1

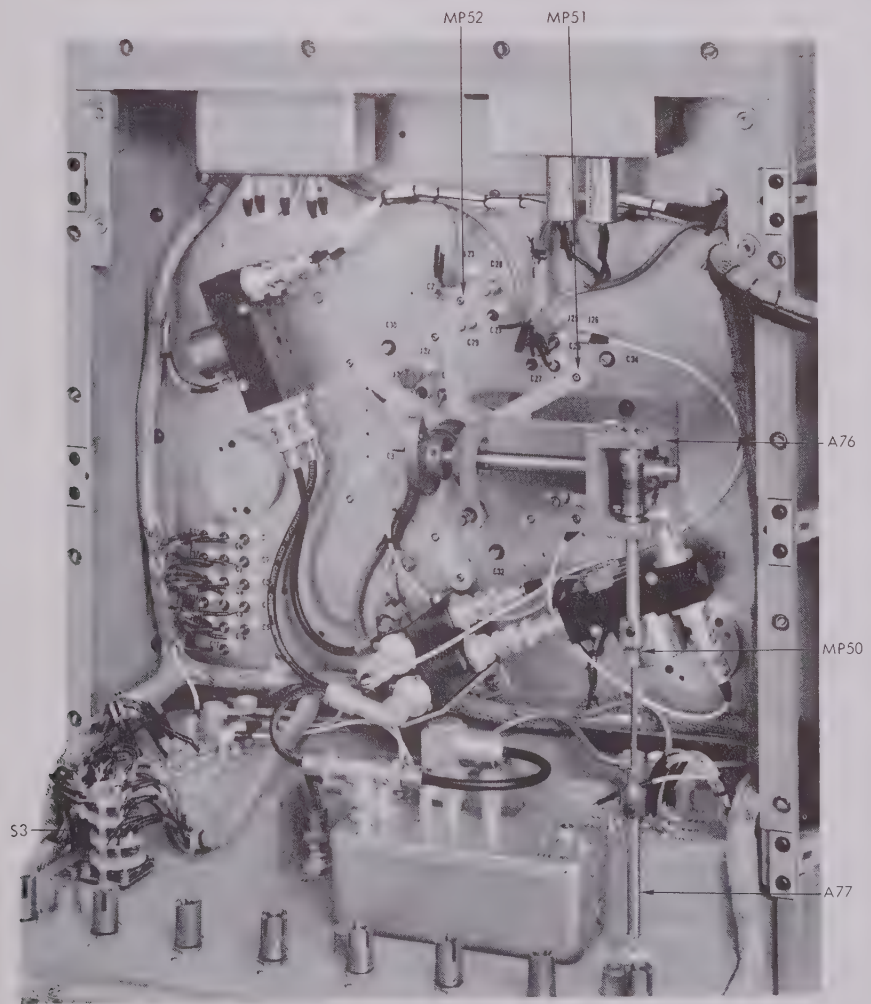


Figure 38-1. Parts Location

38-1. GENERAL.

38-2. The main tuning assembly is essentially a gang tuning mechanism for all tuning capacitors. The FREQUENCY control sets the pointer for the dial assembly (see figure 38-3) and tunes the capacitors through the capacitor drive assembly (see figure 38-2). Band switch S3 also selects the proper dial for the selected frequency band.

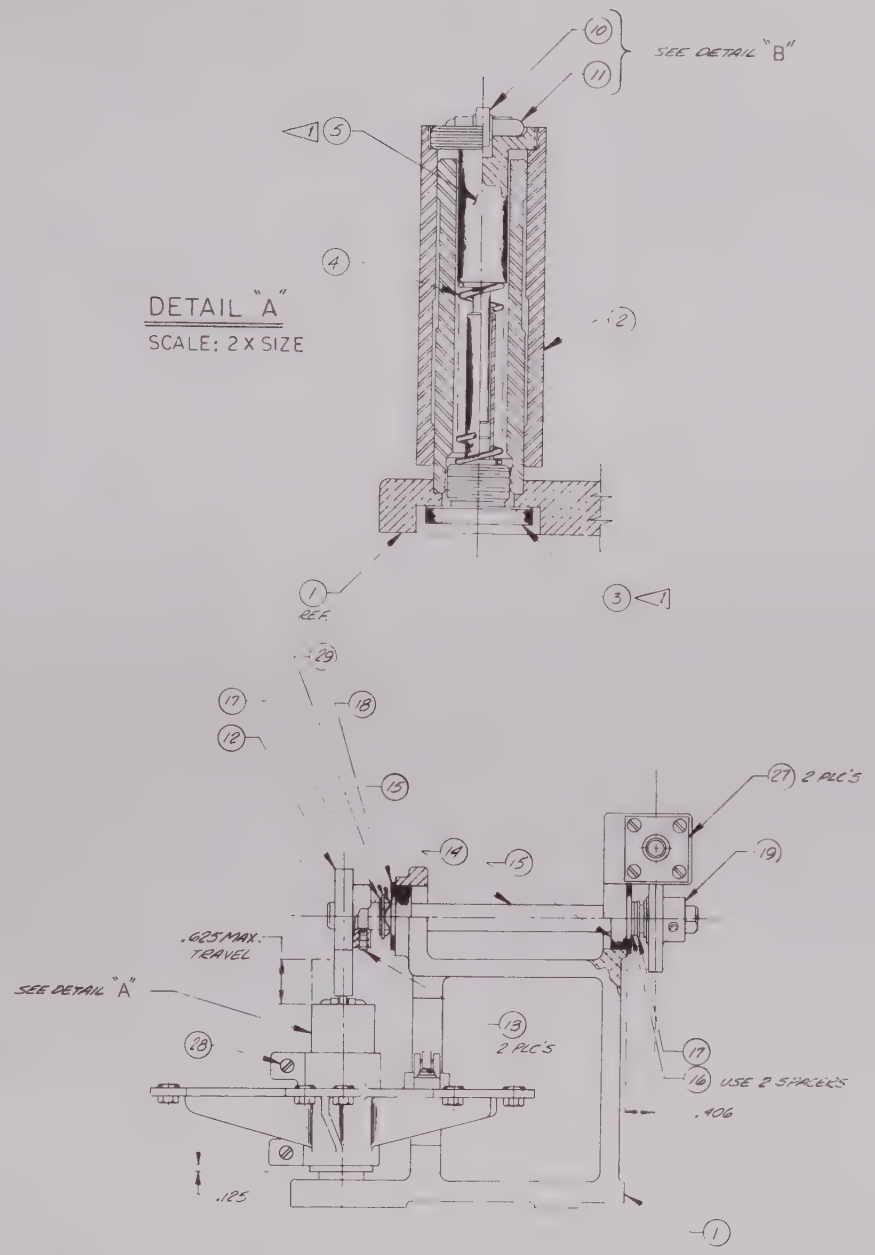
38-3. Tracking and accuracy of the frequency dial are both dependent on exact adjustment of the control train. Exactly 19 turns of FREQUENCY control must result in exactly 0.625 inch travel of the pistons of the tuning capacitors. At the start of travel, the pistons of the capacitors must be exactly flush with the body (turret side) and the pointer of the dial must be set to the minimum frequency position. The 19 turns of travel must result in 285° rotation of cam (MP12 of figure 38-2), .625 inch of capacitor piston travel, and full travel of the dial pointer.

38-4. Any change in the adjustment of the control train therefore requires a complete retuning of the unit. Field repair should be restricted to cleaning or lubrication to eliminate mechanical interference. If field adjustment must be attempted, refer to figure 38-2 for critical dimensions of the capacitor drive assembly and to paragraph 38-3 for final adjustment limits.

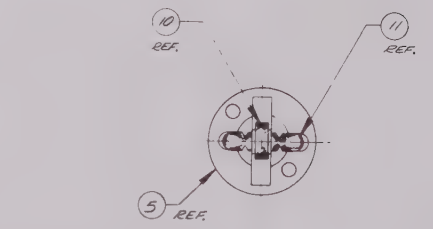
38-5. Band switch S3 is mounted to allow rotation of the switch in its mounting. This adjustment may be used to improve the readability of the frequency bands.

CAPACITOR DRIVE ASSEMBLY
A76

REF DESIG	ITEM	MFR	PART NO.
MP1	Support	Singer	OM-1430
MP2	Sleeve Assy	Singer	AA-1076
MP3	Guide Assy	Singer	AA-1115
MP4	Spring	Singer	OM-1344
MP5	Guide Assy	Singer	AA-1116
MP6	Spider	Singer	OM-1431
MP7	Support Assy	Singer	AA-1175
MP8	Support Assy	Singer	AA-1176
MP9	Setscrew, No. 4-40 by 1/4 in. lg	Long-Lok	LL57XD40K4
MP10	Bearing	New Hampshire	SR144PPEEK25
MP11	Roller, needle	Torrington	M-484-Q
MP12	Cam	Singer	OM-1451
MP13	Setscrew, spline socket, cup pt, 6-32 by 1/4 in. lg		
MP14	Shaft	Singer	OM-1271
MP15	Bearing	Barden	SFR6FF3
MP16	Spacer	Singer	OM-1269
MP17	Retaining ring	Waldes Kohinoor	5100-37
MP18	Spring washer	Shakeproof	3515-20-17
MP19	Gear Assy	Singer	AA-1114
MP20	Bearing	Barden	SR4FFT3
MP21	Shaft Assy	Singer	AA-1113
MP22	Stop Assy	Singer	AA-1112
MP23	Setscrew, spline socket, cup pt, 6-32 by 1/4 in. lg		
MP24	Spacer	Singer	OM-1270-1
MP25	Spacer	Singer	OM-1270-2
MP26	Washer, spring	Shakeproof	3515-14-11
MP27	Retainer	Singer	AS-1028
MP28	Screw, mach, binder hd, 4-40 by 3/8 in. lg		
MP29	Spacer	Singer	OM-1269-1
MP30	Screw, mach, pan hd, 4-40 by 3/8 in. lg		



NOTE: All callouts on this drawing are prefixed by the letters "MP" in the parts list.



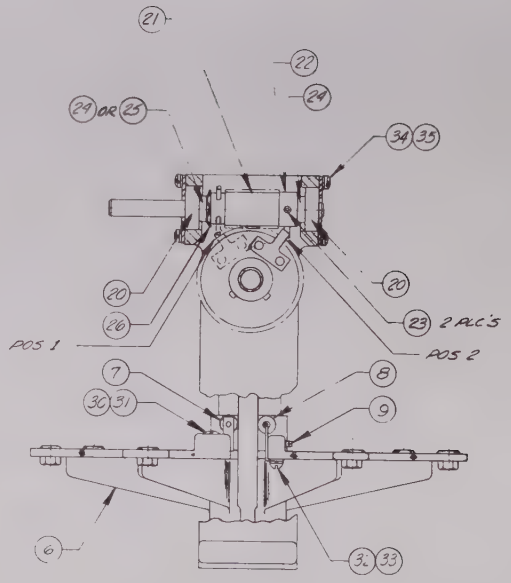


Figure 38-2. Parts Location

REF DESIG	ITEM	MFR	PART NO.
MP31	Lockwasher, internal tooth, No. 4		
MP32	Screw, mach, rd hd, No. 4-40 by 3/8 in. lg		
MP33	Lockwasher, split ring, No. 4		
MP34	Screw, mach, pan hd, No. 2-56 by 1/4 in. lg		
MP35	Lockwasher, internal tooth, No. 2		

DIAL ASSEMBLY
(See figure 38-3)

REF DESIG	ITEM	MFR	PART NO.
DS12	Lamp	GE	TS51
DS13	Lamp	GE	TS51
DS14	Lamp	GE	TS51
DS15	Lamp	GE	TS51
DS16	Lamp	GE	TS51
DS17	Lamp	GE	TS51
DS18	Lamp	GE	TS51
DS19	Lamp	GE	TS1819
XDS12 thru XDS19	Socket	Dialco	7-05
MP1	Pointer	Singer	AS1230
MP2	Setscrew, spline socket, cup pt, No. 4-40 by 1/4 in. lg		
MP3	Spring	Singer	AS-1218
MP4	Screw, pan hd, No. 4-40 by 1/4 in. lg		
MP5	Lockwasher, split ring, No. 4		
MP6	Block	Singer	OM-1536
MP7	Setscrew, No. 4-40 by 3/16 in. lg	Long-Lok	LL57XD40K3
MP8	Guide rod	Singer	OM-1528
MP9	Screw, socket hd, 6-32 by 5/8 in. lg		
MP10	Lockwasher, split ring, No. 6		
MP11	Sprocket	Singer	OM-1525
MP12	Bushing	Singer	OM-1527
MP13	Chain	Sierra	9000-130
MP14	Retaining ring	Waldes Kohinoor	5100-18
MP15	Sprocket	Singer	OM-1524
MP16	Shim, 0.002 in. thk, 0.187 ID, 0.375 OD		
MP17	Shim, 0.005 in. thk, 0.187 ID, 0.375 OD		
MP18	Gear	Armac	F48-72-B
MP19	Roll pin	ESNA	79-012-062-0250
MP20	Setscrew		AN565DC2H2

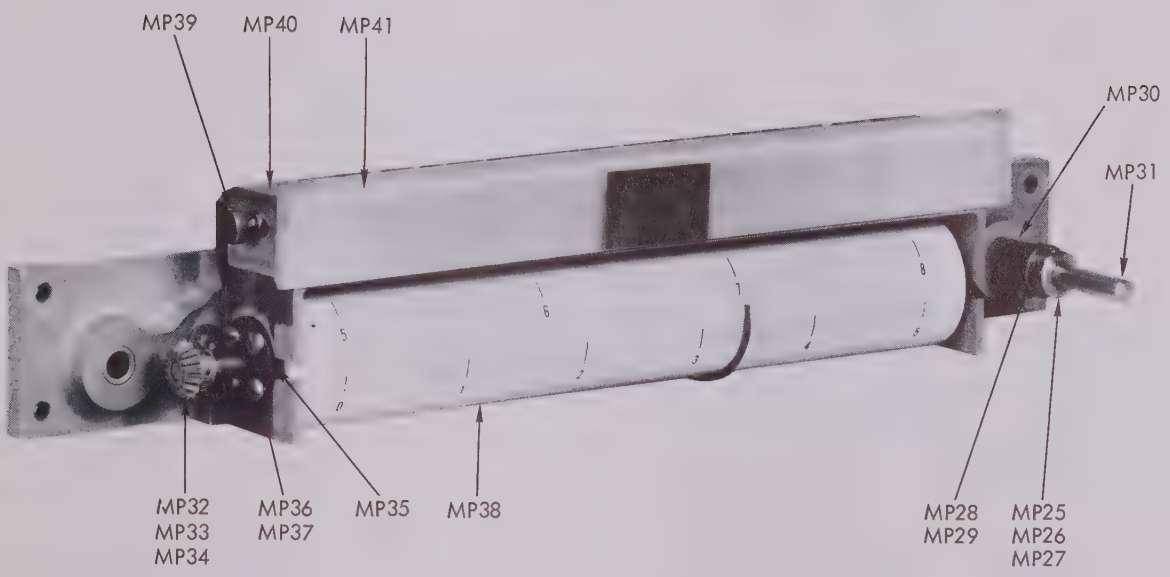


Figure 38-3. Parts Location (Sheet 1 of 2)

REF DESIG	ITEM	MFR	PART NO.
MP21	Retaining ring	Waldes Kohinoor	5100-18
MP22	Shim, 0.002 in. thk, 0.187 ID, 0.375 OD		
MP23	Shim, 0.005 in. thk, 0.187 ID, 0.375 OD		
MP24	Sprocket	Singer	OM-1526
MP25	Collar	PIC	CI-3
MP26	Roll pin	ESNA	79-012-062-0500
MP27	Setscrew, spline socket, cup pt, No. 6-32 by 1/8 in. lg		
MP28	Washer, Flat, 1 4 in. ID		
MP29	Washer, spring	ESNA	3515-14-11
MP30	Bushing	Singer	OM-1531
MP31	Gear Assy	Singer	AA-1211
MP32	Gear	Singer	OM-1539
MP33	Roll pin	ESNA	79-012-062-0250
MP34	Setscrew, spline socket, cup pt, No. 4-40 by 1 8 in. lg		
MP35	Flange	Singer	OM-1519
MP36	Screw, pan hd, No. 4-40 by 3 16 in. lg		
MP37	Lockwasher, split ring, No. 4		
MP38	Chart	Singer	AW-1406
MP39	Thumb screw, No. 4-40 by 1 4 in. lg	Federal	33000NP
MP40	Cover	Singer	AS-1229
MP41	Lens	Singer	AA-1212
P50	Connector	Amphenol	126-220

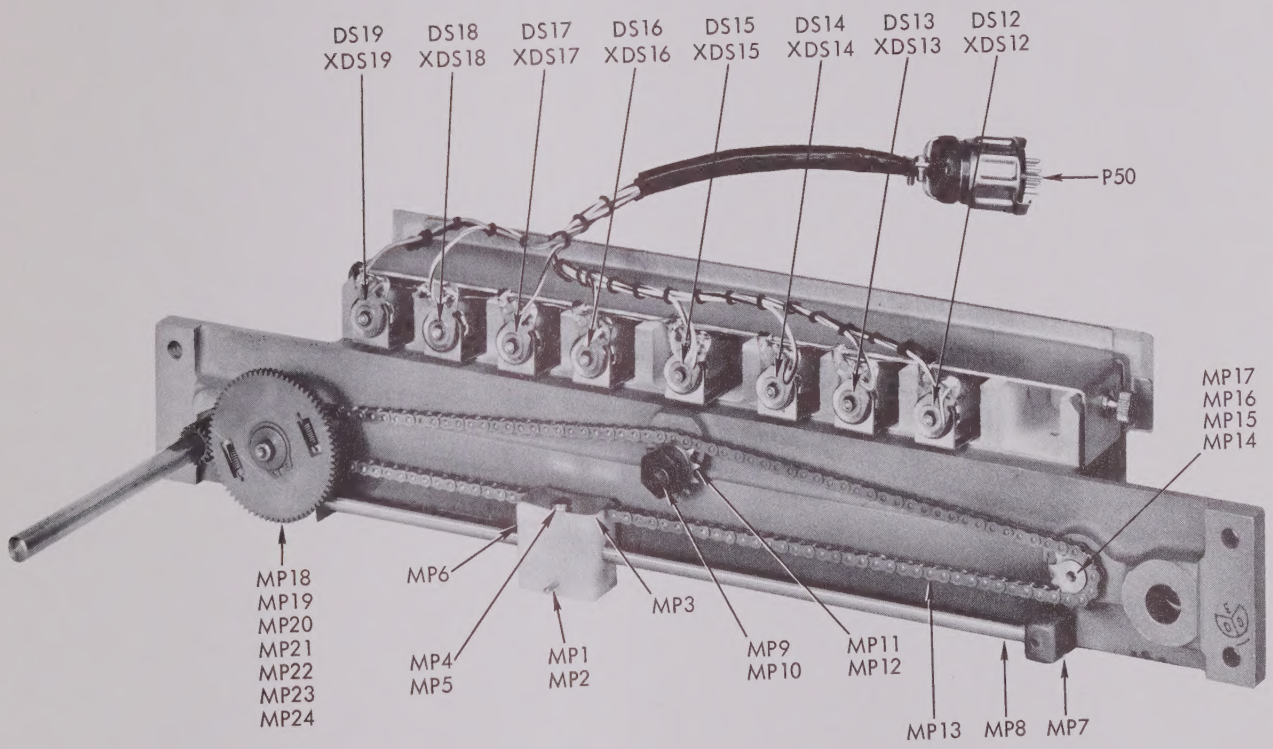


Figure 38-3. Parts Location (Sheet 2 of 2)

R2
F4